DOCUMENT RESUME

ED 267 673 HE 019 127

AUTHOR Chacon-Duque, Fabio J.
TITLE Building Academic Quality in Distance Higher Education. A Monograph in Higher Education Evaluation and Policy.
INSTITUTION Pennsylvania State Univ., University Park. Center for the Study of Higher Education.
PUB DATE 85
NOTE 72p.; Research based on doctoral dissertation project.
AVAILABLE FROM Pennsylvania State University, Center for the Study of Higher Education, 325 Pond Lab, University Park, PA 16802 ($5.00, prepaid; $6.50, on invoice).
PUB TYPE Reports - Research/Technical (143) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Academic Achievement; Academic Persistence; College Programs; *Distance Education; *Educational Quality; Grades (Scholastic); Higher Education; Instructional Materials; *Models; *Outcomes of Education; Path Analysis; *Predictor Variables; Program Evaluation; Questionnaires; Regression (Statistics)
IDENTIFIERS *Pennsylvania State University

ABSTRACT

The factors that determine course completion and achievement in college distance education were investigated using a sample of 25 courses offered through the Independent Learning Program at the Pennsylvania State University. The main objective was to develop a multivariate model to explain and predict outcomes of distance education. Additional objectives were: to develop a methodology for evaluating on-going distance education projects; and to establish guidelines for program planning and course design/implementation. Student variables, instructional variables, and institutional support variables affecting outcomes in distance education are summarized, based on previous research in the field. The final outcomes model includes 10 variables out of 30 that were measured and 35 that were identified from the literature. Findings indicate that the most important variables in determining outcomes are related to instructional materials, the institutional support provided to students, and students' academic persistence. A high proportion of the outcomes can be explained by the path model and two intervening variables: course difficulty and student persistence: moderate difficulty enhances both completion and pass rate. The Faculty Questionnaire on Independent Learning System is appended. (SW)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED267673

BUILDING
ACADEMIC QUALITY IN
DISTANCE HIGHER EDUCATION

A Monograph in

Higher Education Evaluation and Policy

by Fabio J. Chacón-Duque, Ph.D.

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Pennsylvania State Univ

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

HE019127

The Pennsylvania State University
325 Pond Lab
University Park, PA 16802

BEST COPY AVAILABLE

The Center for the Study of Higher Education

The Pennsylvania State University

BUILDING ACADEMIC QUALITY IN DISTANCE HIGHER EDUCATION

A Monograph in

Higher Education Evaluation and Policy

by Fabio J. Chacón-Duque, Ph.D.

The Pennsylvania State University

University Park

Fall 1985

Not to be reproduced in whole or in part without the express written consent of the author.

ACKNOWLEDGEMENTS

As the present monograph originates in a doctoral dissertation project, the author wishes to express his gratitude to all institutions and persons that made possible both the completion of the program and the present study. Special thanks are in order to Fundación Gran Mariscal de Ayacucho, from Venezuela, and to the Center for the Study of Higher Education at The Pennsylvania State University for providing institutional support to this author during his doctoral studies. Thanks are also extended to the Fulbright Foundation for supporting a pilot project in 1983 that was instrumental in the design of the present study.

The cooperation of all people in the Department of Independent Learning at Penn State was determinant for success in the crucial stage of data collection. The author wants especially to mention the following persons: Dr. David Mercer, director of the service, for his resolution in carrying out the study and his opportune general information about the program; Stephen Wright, for invaluable support in the application of the instructor's questionnaire; Mary Eisenbach and Earl Mann, for guiding comments about the organization of the system's files and the many times they interrupted their work to answer questions; Judy Kelly and Donald Hild, for documentation on the instructional publications subsystem; Toni McMullen, Carol Vendershot, and Ellen Gfroehrer, for help with the review of student files and also the many questions answered; and Anita Colyer for assistance in the search of materials.

Special thanks are also expressed to Dr. William Toombs, thesis advisor and chairman of the author's doctoral committee, whose skilled integration of suggestions to the original proposal contributed to refine its design. In this respect, the author is indebted too to Dr. Sebastian Martorana, Dr. Robert Hendrickson, and Dr. David Allen, who served in the committee; and to Dr. Dennis Roberts and Dr. James Fairweather for comments on the methodology.

ABSTRACT

This study explored the factors that determine course completion and achievement in distance higher education, and their patterns of influence. To address these issues involved a process of: describing critical variables in distance education programs; finding significant bivariate relationships; grouping interrelated variables into regression models; and connecting a set of conceptually interpretable and statistically valid regression models into a causal path model.

The study was conducted on a sample of 25 courses offered through the Independent Learning Program at the Pennsylvania State University. The dependent variables were aggregate indicators: the completion rate of the students enrolled in each course, their average of grades, and the pass rate. It was assumed that these outcomes were a reflection of entry characteristics of the students, quality of instructional presentation in the materials they used, and institutional support provided through distance instructors.

The findings indicate that a high proportion of the outcomes can be explained by a path model, in which two intervening variables seem to play a central role: the difficulty of the course and the perseverance of the student towards completion. Apparently, they interact in a non-linear form. Low difficulty influences early attrition and high difficulty causes late attrition and lower pass rate; while moderate difficulty enhances both completion and pass rate.

In turn, variables that increase difficulty are: the work load or amount of assignments in the course; the academic load of the instructor (as it reduces the time available for the students); and his/her focus on reactive, assessment-centered, support. Persistence is enhanced by: good quality of instructional presentation in textbooks and study guides; variety of media in the course; and planned, student-centered, support. Presentation quality is negatively affected by the number of semesters a course has been offered. Contrastingly, the individual variables (i.e. attainment, age) showed little impact.

These results are significant for establishing policies about the independent study system such as periodically redesigning the courses, regulating the work load of the student, establishing criteria for selecting and producing print materials, setting standards for institutional support, and providing special training to participant instructors.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	ii
ABSTRACT	iii
LIST OF TABLES	vi
LIST OF FIGURES	vi
Chapter	
ONE: INTRODUCTION	1
Statement of the Problem	1
Context	1
Definition of Distance Education	2
Central Question	3
Research Paradigm	3
Purposes of the Study	5
TWO: THEORETICAL AND METHODOLOGICAL BACKGROUND	7
Variables Affecting Outcomes of Distance Education	7
Student Variables	7
Instructional Material Variables	9
Institutional Support Variables	12
Summary of Relevant Variables	14
Setting of the Study	14
Unit of Analysis	18
Sampling Procedures	19
Data Collection Procedures	19
Hypotheses of the Study	20
General Hypothesis	20
Specific Hypotheses	20
Operationalization of Variables	21
Dependent Variables	21
Student Variables	21
Instructional Media Variables	22
Institutional Support Variables	32
THREE: FINDINGS	23
Descriptive Overview	23
Student Subsample	23
Faculty Subsample	23
Instructional Materials Subsample	23

Three...(continuation)

Analysis of Bivariate Relationships 24
Relations Between Individual Variables and Outcomes 24
Relationships Between Institutional Support Variables and Outcomes 27
Relationships Between Instructional Material Variables and Outcomes 27
Evaluation of Hypotheses 1, 2, and 3 28

Regression Analysis: Submodels 29
Submodel 1: RPASS 29
Submodel 2: RCOMP 29
Submodel 3: MTIMC 30
Submodel 4: MVAR 30
Submodel 5: FSUPP 30
Evaluation of Hypothesis 4 31

Final Causal Analysis 31
Evaluation of Hypothesis 5 35

FIVE: CONCLUSIONS AND RECOMMENDATIONS 39

Review of Research Questions 39
Question 1: Completeness of the Model 39
Question 2: Implications for Theory on Distance Education 40
Question 3: Strengths and Weaknesses of Causal Modeling 43
Question 4: Recommendations for Policy ... 43
Question 5: Limitations to Generalization of Results 47

External Implications of the Study 48
Confirmation of Relevance of the Cognitive Approach to Text Design 48
Implications for Decision Support Systems 49
Recommendations for Future Research 50
Final Comments 51

BIBLIOGRAPHY 53

APPENDIX A: FACULTY QUESTIONNAIRE ON THE INDEPENDENT LEARNING SYSTEM 61

LIST OF TABLES

Table		Page
1a	Summary of Student Variables Affecting Outcomes in Distance Education Programs	15
1b	Summary of Instructional Material Variables Affecting Outcomes in Distance Education Programs	16
1c	Summary of Institutional Support Variables Affecting Outcomes of Distance Education Programs	17
2	Descriptive Statistics of Aggregate Variables for 25 Courses	25
3	Correlations Among Individual Student Variables	25
4	General Correlation Table Among Selected Variables	26
5	Predictor Errors for Path Submodels (Standardized Variables)	37
6	Decomposition of Selected Correlation Coefficients Through Compound Paths	38

LIST OF FIGURES

Figure		Page
1	Heuristic Model of the Study	4
2	Final Path Model of Distance Education Courses	33
3	Generalized Model of Distance Education Course Outcomes	42

INTRODUCTION

It seems that every educational innovation must undergo a cycle of trial, instrumentation, organizational settlement, and evaluation. Evidence for this general cycle of development is found in pioneering work by Rogers (1962) and in a comparative study of changes in colleges and universities by Martorana and Kuhns (1975, p.179). During the trial stage, there are a few individuals who start using the innovation, usually facing a good deal of resistance. In the second stage, the major concern is to diffuse the innovation, to train others in the "know how." Consequently, there is an emphasis in methods, procedures, and instruments. When the innovation has shown certain degree of success, it becomes institutionalized; usually, departments or units are created for systematizing the innovation technology and coordinating applications. Finally, after several years, sometimes decades, researchers attempt to answer by systematic study the questions that were in the educators' minds since the inception: Does the innovation actually work? What is its impact on learning? What factors are essential to improve outcomes? How does it compare to other alternatives in terms of costs-benefits? This is the moment of evaluation. It is interesting to observe that this process is repeated even when the innovation is not "new" but it has been transferred from an institutional milieu or from one country to another.

The present study deals with the evaluation of distance education or independent study at the postsecondary level, an innovation that has existed for quite awhile but still is not sufficiently evaluated. It attempts to provide answers to some of the questions mentioned above. This introduction deals first with the elements that contribute to focus the problem of the study: a brief contextualization of the innovation, some relevant definitions, and the key question to be addressed. Secondly, it postulates the heuristic model used for inquiry and the research purposes.

Statement of the Problem

Context

Distance education is a rapidly growing alternative of access to higher education in both the developed and developing countries. Recent reviews (Holmberg, 1981; Neil, 1981; Daniel et al. 1982; Kaye and Rumble, 1982; and Feasley, 1983) suggest that this mode of instruction is achieving institutional maturity, as it becomes an important complement to the mainstream educational systems. The patterns of institutionalization of distance education vary among countries. Some of them have created independent "open universities," such as England, Spain, India, West Germany, Pakistan, Venezuela, Costa Rica, Israel, and Canada. In others, such as United States, the Soviet Union, and Australia, the trend is for a remarkable expansion of distance programs attached to conventional colleges and universities. In the United States alone, the Peterson's Catalog for Independent Study (Hunter, 1983), lists 72 universities offering over 12,000 courses through this system. To this figure, one must add some 50 more institutions--colleges and professional associations--catalogued by Lewis (1983).

Despite this growth of distance education, there are still many unanswered questions regarding its effectiveness, quality of outcomes,

cost/benefit ratio, and suitability for the student. However, to answer them is not an easy task due to certain problems inherent to research in this field. Some major difficulties found by investigators and evaluators of distance education are the following: (1) There are practical limitations for the observation of students' responses, as they occur far away from the institution; (2) the instructional conditions are difficult to appraise, since a wide variety of strategies and media are used to teach and inter-personal contacts is restricted; (3) an homogeneous environment like the campus is lacking, which adds complexity to the variables involved in the process; and (4) immediate correction of errors is impossible, because the system operates in an industry-like fashion. Once the courses are developed and delivered it is costly to modify them. As a result of these problems, the theoretical and methodological basis of research in this setting are unclear. Coldeway (1982, p.30) suggests that "there is no clear paradigm for research in distance learning and it is difficult to attract funds to develop one."

The overall unclearness of evaluative research in the field of distance education has frustrating consequences for program administrators and practitioners. They rely for their decisions on a number of loose assumptions. Examples of them are: (1) the learning objectives must be always presented for each segment of instruction; (2) adding more technological media--i.e., television, computers--to the instructional system may improve the learners' outcomes; and (3) is that students must be assessed as often as possible, in order to provide immediate feedback to each instructional unit. These assumptions often remain untested until icongruities are found. McCormick (1977) is sharply aware of this problem when he points:

> The only thing that is conspicuously missing from the evaluation literature is any full discussion of a revision model for course improvement. [...] Thus professional evaluators have given little guidance on how to use the information thrown up by the many models of evaluation theory and this lack of a revision model renders much of the evaluation efforts useless. (p. 208)

The implications of this statement for the policies on production, implementation, and revision of distance courses are quite bleak; unless that attempts are made of building explanatory, validated, models. This argument will be examined in the context of the general conclusions of the study.

Definition of Distance Education

The extraordinary expansion of distance education, among other forms of non-traditional learning programs, has created a variety of terms that adds more confusion to research. Wedemeyer (1981) points that: "The terminology of non-traditional learning programs obscures the similarities that exist among the programs and suggests a greater diversity than actually exists." (p. 47). In attention to this problem, it is convenient to dedicate some lines to clarify what kind of programs are the subject of the study.

In the first place, the term that will be used here is "distance education" instead of "correspondence instruction," "independent

study" or "open learning," also popular terms, because the former is the most descriptive. The others have implications that may contribute to obscure their meaning; i.e., that the dominant medium is correspondence, that study can be actually independent of any influence, or that--by contrast--some kinds of learning are "closed." Desmond Keegan (1980) established the basis for a general definition of distance education by combining statements of several authors and comparing similarities of programs existing to date. His definition is representative of the state-of-the-art in this area as of the 1980's and it states:

> The main elements of a definition of distance education are:
> --The separation of teacher and learner, which distinguishes it from face-to-face lecturing;
> --the influence of an educational organization, which distinguishes it from private study;
> --the use of technical media, usually print, to unite teacher and learners and carry the educational content;
> --the provision of two-way communication so that the student may benefit from or even initiate dialogue;
> --the possibility of occasional meetings for both social and didactic purposes; and
> --the participation in an industrialized form of education which, if accepted, contains the genus of radical separation of distance education from other forms. (p. 33)

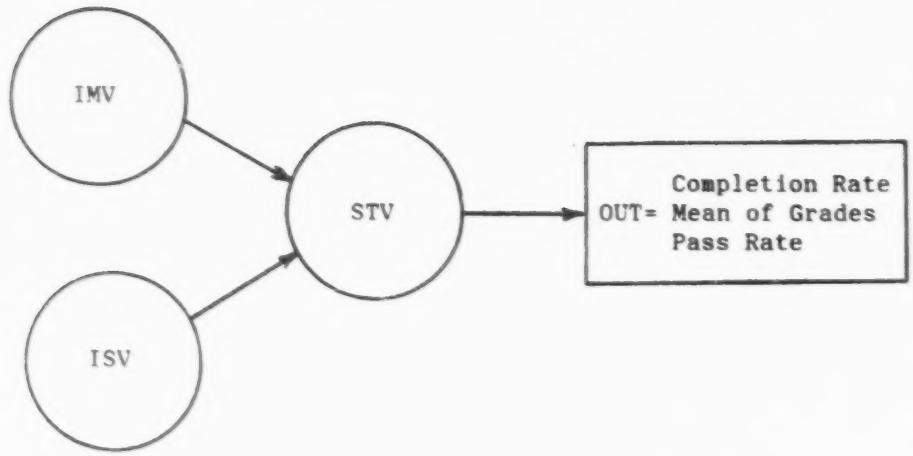
Central Question

A key problem of any educational innovation is to insure outcomes that are comparable or better than those of the mainstream systems. These outcomes can be measured through the traditional indexes of grades, completion, student satisfaction, cost/benefit ratio, and so forth. Therefore, an initial formulation of the leading question of this study was: What factors are essential to improve outcomes of distance education? However, this question was too broad. In fact, the critical variables of distance education have been studied for more than three decades, and a considerable output of literature has been produced. However, there is still a lack of comprehensive studies that integrate these variables in explanatory models. This study was conceived then as an attempt to fill this gap by integrating a number of program variables into an explanatory model of course outcomes. The original question was rephrased as follows: What variables determine the output in distance higher education courses and what are the patterns of influence existing among these variables?

Research Paradigm

To investigate the former question, and some others derived from it, it was decided to use a heuristic model for the design of the study. This model, displayed in Figure 1, defines the relevant groups of variables and the hypothetical relationships among them. It postulates that distance education outcomes are mainly a reflection of three categories of factors, frequently mentioned in the current literature (Kaye and Rumble, 1981a; Holmberg, 1982). These are the following:

(1) Student variables, such as motivation to study, mastery of study skills, and previous experience with content;
(2) Instructional media variables, referred to the pedagogical quality of reading materials and accompanying media;



IMV= Instructional Media Variables STV= Student Variables
ISV= Institutional Support Variables OUT= Educational Outcomes

Figure 1. Heuristic Model of the Study

(3) Institutional support variables, such as intensity of guidance provided by advisors or counselors, type of interaction that they have with students, turn-around time of assignments, access to library facilities, and availability of two-way communication channels (i.e., telephone, correspondence, or group discussion).

The outcome variables of distance courses will be defined on the basis of three indicators used in previous research (Woodley and Parlett, 1983). They are based on aggregate data; in other words, the unit of analysis is the "course cohort" or group of students enrolled in a course during a particular period. They can be briefly defined as follows:

(1) Course completion rate, or ratio of students who register for a given course and stay to the end;
(2) Pass rate, meaning the proportion of students who achieve the criterion of sufficiency in the course;
(3) Class grade average, represented by the arithmetic mean of the grades obtained by the cohort of students in a given course.

Purposes of the Study

The major purpose of the present study was to develop and test a multivariate model to explain and predict outcomes of distance education. This model can be used as a tool for evaluation, research, and policy analysis on a diversity of issues. In order to construct this model, a number of variables belonging to the previously mentioned categories were measured and their relationships were tested through appropriate statistical procedures of analysis of variance, correlation, regression, and path analysis. These procedures enabled the researcher: (1) To determine the strength and significance of bivariate relations; (2) to establish the relative importance of each independent variable as predictor of the dependent variables; and (3) to define empirically tested patterns of interaction or paths of influence within and between the sets of variables.

A second purpose of the study was to develop a suitable methodological approach for evaluating on-going distance education projects. Three methodological guidelines were set in order to accomplish this intent. First, the data collection procedures relied on available data of the educational project whenever it was possible. Second, the measurement procedures were unobtrusive with respect to the system operation; they did not cause special activities of the project members. Third, the investigation procedures were carried out as if they were part of the usual duties of gathering information to monitor operations. By applying these three guidelines, it was insured that the design and instrumentation of the study can be transferred to similar projects in the future.

A final purpose of the study was to establish guidelines for setting policies on a number of pressing issues in distance education. It follows a non-exhaustive list of policy questions that can be addressed through the model; they are classified into four areas of interest that are typical of in this context:

(1) Program Planning.
-- What changes are advisable in the program goals?

-- What changes are advisable in course objectives?
-- What is the best sequence of courses in a given academic program?

(2) Course Design
-- What kind of training is recommended for the professors who work as course authors?
-- What combination of media is going to be used in a particular course?
-- What is the optimal academic load for that course in terms of learning activities and assignments?
-- What is the desirable frequency of submission of assignments?
-- What instructional presentation techniques should be enhanced in textbooks and study guides?
-- What elements of feed-back must be considered when designing take-home or directly supervised assignments?
-- How can student involvement be promoted in a distance education situation?

(3) Course Implementation
-- What resources are necessary at the academic department level for effective administration of courses?
-- What kind of training should be provided to the professors who will work as student tutors?
-- What kind of information is needed from and by the students at the moment they enroll for distance courses?
-- What functions are needed from student counselors in order to handle the problems observed in course implementation?

(4) Course Assessment
-- How effective is each course offered by the distance education system in terms of student completion and achievement?
-- What courses should be revised to improve general completion and achievement rates?
-- How distance courses compare to regular courses in terms of usual parameters of completion and achievement?

In summary, the evaluation research model developed and tested in the present study can be conceived as the basis for an information system for distance education programs that may accomplish the following functions: (1) to gather data about students, courses and institutional activities; (2) to analyze and summarize the data by means of statistical and logical procedures; (3) to provide information for policy-making in the instructional area; (4) to test hypotheses of general interest for the field of distance education. Furthermore, the system can gradually be improved by adding or changing variables, refining measurement procedures, and stating new hypotheses.

THEORETICAL AND METHODOLOGICAL BACKGROUND

Variables Affecting Outcomes of Distance Education

The evaluation model proposed in the former chapter is based on the premise that it is possible to establish causal linkages between a number of program input variables in distance education, and the observed outcomes--i.e., student achievement, student satisfaction-- of these programs. If these linkages and their relative strengths are known one may alter program variables in certain ways in order to improve outcomes; which is a major goal of evaluation. It is convenient, then, to look at the existing evidence on the individual, instructional, and institutional variables that influence distance education outcomes, prior to include these variables for testing in a model.

Student Variables

When dealing with individual variables, one must look first at a set of "classical" parameters whose influence in educational outcomes has been widely tested in all sub-fields of education. These are mainly: socioeconomic background, intelligence and abilities, and academic attainment. Socio-economic background (Alexander, 1975; Jencks and Riesman, 1967) determines many aspects of the learning situation; i.e., the availability of learning resources, the choice of college, the type of interaction with peers, and the student's self-image. With respect to intelligence and abilities (Cronbach and Snow, 1967) it can be roughly stated that the general level of ability determines both the amount and complexity of learning. Academic attainment, as represented by the time spent in college by an individual, has been identified as the best predictor of student persistence in higher education (Hilton, 1982, p. 1). In a study on distance learners, Woodley and Parlett (1983, p. 17) also found that this factor was the best predictor of the pass rate of course cohorts.

The problem that these variables represent for educational policy-makers is that they are largely unalterable through actions of the academic institutions. As reaction to this problem, a more recent trend of research, exemplified by Bloom, Madaus and Hastings (1981) suggests that educational inquiry and practice would do better if they focus on "alterable variables," those that can be modified by educators. Among these, the authors include: the time elapsed on the study task, the level of motivation for the task, and the familiarity with specific content. All of these have the possibility of positively influencing the student's results.

The time-on-task refers to hours spent by the learner in actual interaction with instructor and/or instructional material. It differs from the official time established for the duration of a course. The quoted authors found that the former was directly responsible for gains in learning, while there was little correlation among the official time and amount of learning.

The level of motivation seems to interact closely with the time dedicated to the task in distance programs, as shown in a study by Schwittmann (1982) of the attendants to the German Funkkolleg, a multi-

media college program with emphasis foundation courses. According to this author, the pattern of time use by learners is determined by their perseverance which, in turn, depends on affective involvement and on the quality of learning materials.

Familiarity with specific content has been conceptualized by cognitive psychologists of the "schema theory" (Schallert, 1982) as the single most important element to determine learning in humans. Cognitivists theorize that, throughout life span, individuals develop structured representations of things or "schemas" that summarize many individual instances of information. In these structures, components are connected to each other in such way that new information immediately evokes related information in a person's mind, creating expectations. If expectations are fulfilled, comprehension and learning occur. If they are not fulfilled, the person may distort the information to make it fit in his structures, or he may discard it as trivial.

Out of the realm of the classical variables, studies by Marton and Svensson (1982) on European students of distance higher education programs stress the importance of certain study skills and the learner's orientation to studies. They stress study skills that allow for improved cognitive processing. This distinction is important because classic studies on the subject tend to rely on mechanical aspects of study; such as, scheduling, duration of study periods, library use, note-taking, use of cards, and rapid reading. These two authors reason that actually effective study skills are those that allow the learner to access the "deep structure" of information, the underlying semantic connections. The deeper the processing, the more elaborate and long-lasting is individual knowledge. Examples of appropriate study skills are: outlining chapters, discarding trivial material, classifying arguments into concepts, and connecting ideas. Distance learners can benefit more than traditional students from these skills since they do not enjoy the benefits of lectures and peer discussions.

Marton and Svensson (1982) found too that use of these skills by distance students was determined largely by the orientation to studies that they assumed at the onset of a program. Orientations are of four main kinds: "vocational, academic, personal, and social" (p. 31); the most relevant for study skills seem to be the academic orientations that, in turn, can be extrinsic or intrinsic. Students with an extrinsic orientation, meaning that they basically are interested in the profit or status aspects of college study, tend to neglect the acquisition of effective information processing skills. By contrast, students with an intrinsic orientation, more interested in content and applications of knowledge, tend to develop that kind of skills. Also, Marland et al (1984) found that intrinsically oriented students were more frequently engaged in mental activities with content than externally oriented students. These activities included: planning of study sessions, elaboration of linkages among ideas, self-evaluation, selection, rehearsal, and comparison.

Finally, some studies have focused on the age of the student as a factor influencing outcomes of distance education. James (1984) points out that the age of the adult correlates with cognitive changes and

states of psychological well-being which, in turn, generate differences in input and output of study activities. His survey of the British Open University students indicated that motivation to study increased steadily with age. However, performance in writing and memorizing material tended to decrease after 40. As these skills are essential for academic work, the general achievement of students is affected negatively.

Instructional Material Variables

The variables related to instructional material are the most directly alterable of the whole group of factors involved in distance education; consequently, they have been more intensely investigated than the others. A primary concern guiding research has been to develop high quality learning materials, which has also been a key element for the public image of distance programs. Practitioners and researchers have mainly derived their quality criteria from two broad traditions in educational inquiry: the study of learning from text and the analysis of effects of different instructional media. Their essential contributions will be discussed in this section.

Most research in the sub-field of reading in the recent years has been done with strong bearing on Cognitive Psychology. The cognitive approach is characterized by an emphasis on the individual's mediating processes instead of his observable behavior. Cognitivists, such as Ausubel and Robinson (1969), Gagné (1978), Rothkopf (1982), and Schallert (1982), see reading as a perceptual and intellectual operation by which new or partially new material is represented and recalled on the basis of the existing cognitive structure or "schemas" of the person. This notion challenges the principles for text design diffused by Behaviorist Psychology and the Programmed Instruction movement. According to them, the key issues are to define clear terminal objectives instead of processes, to break-down knowledge into small units of practice, and to adequately reinforce each sub-unit (Markle, 1964). By contrast, cognitivists advocate the design of text on the basis of structures of knowledge and information presentation strategies, and downplay the role of reinforcement in intellectual learning.

There is evidence, mostly experimental, suggesting that cognition-oriented design techniques are able to increase effectiveness of print material as a learning tool. It follows a partial listing of techniques and relevant research.

--Use of advance organizers (Ausubel and Robinson, 1969, p.316), meaning abstract outlines or conceptual models placed before major units of text, in order to provide the reader with a global idea of content as preparation to actual reading. Advance organizers may be expository when they present directly the conceptual schema of subsequent text; or comparative, when they draw analogies from other sources to introduce new material.

--Use of overviews and summaries (Marland and Store, 1982, p. 81) that have similar purposes to advance organizers, but are written in a lower level of abstraction. Summaries express in concise sentences the main points of a chapter or book, without paying attention to connectedness.

--Statement of Objectives (Marland and Store, 1982, pp. 84-88), used in this context not merely as descriptions of the desired learning results (behaviorist view) but as devices that help the students hierarchize information and divide the text into "clusters" of information related to objectives.

--Use of vocabulary aids (Stahl, 1983), such as explanations of the key concepts at the beginning of a chapter, or glossaries of technical terms inserted as appendixes. Vocabulary aids help the student to identify the conceptual structure of a text.

--Use of verbal redundancy (Gagnè, 1978, p. 632) for stressing important ideas. Examples of redundancy are: to explain a concept in several alternate ways, to repeat key terms along paragraphs, and to use connecting sentences between paragraphs. In general, redundant material is easier to read than very dense material; an extreme comparison will be a narrative piece versus the mathematical demonstration of a theorem.

--Use of staging devices (McConkie, 1977, p.4), defined as ways of pointing to the hierarchical organization of ideas; i.e., to use headings and sub-headings for the purpose of identifying main and subordinate concepts, to underline key terms of sentences, to put the central idea of a paragraph at the beginning, and to group sentences referring to the attributes of an object in a single paragraph. Staging devices are cues to the "deep structure" of the text and they also improve retention (Pichè and Slater, 1983).

--Use of adjunct aids (Rothkopf, 1982, pp. 115-1116), meaning supplementary aids to the reading material, such as case studies, handouts, computation tables, maps, and so forth. They enhance overall effectiveness of learning by providing opportunities to reflect over information.

--Inclusion of adjunct questions (Rothkopf, 1982, pp. 127-129), conceived as highly abstract questions inserted in text to prompt mental elaboration on certain passages. The effectiveness of such questions depends on the willingness of the student to actually think about them.

--Inclusion of review questions (Gagnè, 1978, p. 660), presented often as self-evaluation exercises or questionnaires. They facilitate recall and cognitive organization of content by the reader. There is some evidence (Marland et al., 1984) that these questions are more effective when sample answers are provided elsewhere in the book, because they help the student to focus on the critical information or skills.

--Use of structured tasks (Rothkopf, 1982, pp. 120-122; Mc Conkie, 1977, pp. 32-33), conceived as complex activities that encourage the student to work on information after the reading sessions. In the class situation, these tasks are introduced and guided bay the instructor. In distance education, they have to be carefully planned as part of the text or study guide. They may include case studies, comparison and evaluation of theories, analysis of data, small research projects, or writing essays to address questions introduced in the study guide.

--Use of graphic aids (Macdonald-Ross, 1977), as ways of visualizing concepts or complex relations. It is important to notice that the kind of graphics advocated by research are those establishing linkage between the reader an the conceptual structure of text; they are not merely decorative illustrations.

--Inclusion of study directions (Anderson and Armbuster, 1982), aimed to make the reader more conscious of the cognitive processes involved in successful study and the ways of improving such processes. Study directions focus on the techniques of effective reading: summarization, organization, discrimination, contextualization, and evaluation.

--Use of typographical cues as additional elements to convey text organization (Hartley and Brunill, 1977; Glynn and Di Vesta, 1979). Research on this issue stresses the importance of such devices as: separators of "fields" in the page, variation of typefaces, different levels of headings and subheadings, frames, indentations, and typeface colors as means of guiding the readers attention to the underlying conceptual structure of passages.

All techniques described so far can be grouped under the general title of "mathemagenic aids," suggested by Rothkopff (1982) to mean presentation devices that prompt learning (mathema=learning, genesis=origin). Particularly, Rothkopff applies the term to questions, study directions, adjunct aids, and structured tasks; but it can be generalized to other techniques serving similar purposes.

On a completely different track of inquiry, other authors have been concerned with the combination of media in instruction, instead of the intrinsic characteristics of messages. For instance, Bates (1980) indicates that the impact of instructional television must be seen as depending on combination of: factors related to the general organization of the instructional program, factors related to the televised sessions themselves, and factors related with the learner (p. 412). This rationale can be applied to any other medium used in distance education. In fact, it can be observed that there is parallelism between the scheme proposed by Bates, and the three groups of variables of the research paradigm suggested here: institutional support, instructional media, and student input.

As an instance of application of Bates model can be shown in a study by Woodley and Parlett (1983) on student drop-out at the British Open University. They found that achievement and completion in distance courses was mostly a reflection of six factors: the previous college attainment of the student, the course workload, the variety of media in the package, the use of complementary interactive sessions, the age of the course, and the number of students enrolled in a course. It is worthwhile to discuss each variable in detail, due to the similarity of approaches between that study and the one presently reported. College attainment will be set aside, because it was already analyzed in the context of student variables.

Workload is a measure of the effort of the student in completing course assignments--i.e., readings, papers, and tests. In the study

under reference, it was determined that the greater the workload after a certain level, the higher the likelihood of attrition and the lower the grades. The critical threshold varies for each type of course and student population.

The effect of the variety of media is positive, and it has been confirmed in a number of studies. Bates (1982) shows the clear advantage of using radio and television to supplement readings versus readings alone. Schramm (1977, 56-58) reviewed several studies of multi-media programs in higher education environments; his general conclusion is that students who work with combination of media do significantly better than others.

The course age (Woodley and Parlett, 1983, p. 15-16), meaning the number of years or semesters a course has been offered in a particular program, is an intriguing variable. One may think that the course age is a sort of neutral factor. However, the data show that it is negatively associated with both completion and pass rate. The authors suggest that repeated administrations of a course lead to certain "mechanization" of tutors' behavior when marking assignments; they tend to pay less attention to individual problems.

Institutional Support Variables

This category broadly refers to the set of conditions provided by the institution to facilitate independent learning; i.e., tutorials, communication system, library resources, laboratory facilities, computer terminals, and take-home kits. These components are very heterogeneous, and the only reason for grouping them into a category is that they usually belong to an organizational division for student management. Kaye and Rumble (1981b) conceptualize this division as the "student subsystem" and differentiate it from the "course subsystem," which is in charge of the selection, creation and revision of instructional materials. These authors define the student subsystem functions as follows:

> [It] admits students; allocates them to courses, local centers, tutors and counselors as required; collects their fees; ensures that they receive course materials, and know where and when to attend for teaching purposes (e.g. viewing of broadcasts at local centers), assessment and examination processes; issues certificates to students who have been successful; and maintains the students' records. (p. 232)

This subsystem establishes linkages between the curricular structure of the program and the students. Therefore, there are many ways in which this subsystem can influence students performance. Out of these, the present study will focus in the role of the tutor or advisor that has been analyzed from theoretical and empirical perspectives by Harris (1975), Bääth (1980), Holmberg (1981, 1982a-b), Lewis (1981), Tait and Sewart (1983), and Mejia (1984). The other aspects of the course subsystem have received much less attention than this one.

In general, two major advisory models are described: face-to-face sessions and non-contiguous or mediated tutorials. The first one refers to direct meetings of tutors with students, in which a variety of

instructional and guidance activities may take place. An example of them are the summer schools indicated in the study by Woodley and Parlett (1983) at the British Open University. These are short workshops in which group discussions and practical projects are conducted. They usually have a high positive impact on student achievement and retention. Other systems, rely mostly on one-to-one interaction between tutor and students. Both strategies are costly, because they signify considerable expenses in tutor salaries and facilities.

The second model, more frequently used due to its low cost, refers to a combination of indirect means of interaction between advisors and students: correspondence, telephone calls, feed-back comments added to submitted assignments, and audio-tape tutorials. If correctly planned, these strategies can be as effective as the former ones.

The most relevant research findings about the impact of advisors in distance study, independently of the model on use, may be seen as related to the dimensions of frequency of interaction and nature of interaction. The first one is connected to the density of assignments for each course, the frequency of contacts, and the relative speed of turn-around time of assignments. According to Holmberg (1982a, p. 31), a high density of assignments is associated with early start in the student sending submissions, but there is no evidence of direct correlation with completion or grades. Moreover, he presents data suggesting that many of the assignments for submission can be substituted by self-checking exercises with no appreciable impact on achievement.

Going back to the study by Woodley and Parlett (1983), the number of students enrolled may be an indicator of the inverse of frequency interaction; because, as the number of students under supervision of a tutor increase, his/her possibilities of communication with individual students decrease. The study is not conclusive about the actual connection between these factors and the issue remains open to analysis.

Studies on the nature of interaction present two contrasting pictures of the role of tutors. There is what Holmberg (1981) calls "the primitive notion of the task of tutors in distance study [..] often based on a limited view which concerns the necessity to correct what is wrong [in assignments] and to assess the student's achievement" (p. 88). This role is forced by the nature of the academic system: Students are enrolled to get credits, and the institution demands them to submit lessons and exams to prove their proficiency; then, there must be someone who corrects what is submitted. When the function of advisors is so limited, it may be inferred that their impact on student performance is null or negative, because there is not actual provision of aid to the students. It is possible, however, to enrich this function if it is accompanied by a good use of indirect feedback strategies.

The second picture, more current and strongly avowed by scholars, stresses the components of communication and guidance in distance tutoring. For instance, Paine (1983, p.18) considers that effective distance tutoring is inseparable of the notion of counseling. The tasks expected from the tutor-counselor are broad and complex; Mejia (1983,

pp. 17-26) presents a normative analysis of that includes: vocational guidance; follow-up of students; advisory on learning activities; provision of feed-back; guidance in study skills; institutional information; coordination of on-site learning resources; facilitation of self-development; control of curriculum quality standards; support to group activities; service to community; interaction with other tutors; and academic development. However, despite the desirability of this enriched role of tutors, it is impossible to overlook that many programs simply cannot afford it. What can be done in these cases is to add to the same elements of indirect feed-back.

Summary of Relevant Variables

The former discussion has succinctly introduced the major contributions of research and theory regarding the leading question under analysis: What factors, and under what patterns of influence, determine the outcomes of distance education at the post-secondary level? It is convenient to summarize these variables in a set of tables that can be used as reference for further sections of this report. This is the purpose of Tables 1a, 1b, and 1c, which refer to the major categories of variables; respectively: students, instructional media, and institutional support. It can be observed there that, in a little more than two decades, a good deal of information has been built about what is essential to make distance programs highly successful. However, one of the current problems is how to integrate this information into actual practice. It is necessary to construct comprehensive models that indicate not only the impact of individual variables, but also their patterns of interaction. The latter is a key point for policy analysis.

Setting of the Study

The study was conducted at The Pennsylvania State University (PSU) Department of Independent Learning (DIL), which is one of the largest facilities for distance education in the United States. This program is a dependence of the University Division of Learning and Telecommunications. It currently (1985) offers,in cooperation with the academic departments, near 280 courses in a wide variety of specialties. These courses may be taken as credit or non-credit, depending of the objective of the participant. By the time the sample was drawn, July 1983 to June 1984, the program had 17,108 course enrollments (DIL, 1984, p. 1). This amount went down to 16,354 in 1985, reflecting a tendency that has been evident since 1982 (DIL, 1985, p. 3). The program serves mainly the state of Pennsylvania but also other states, such as California, Texas, Maryland, New York, and New Jersey have considerable numbers of users. There are a few students in foreign countries.

The whole system is coordinated by a Program Office located in the central campus of PSU, but all decisions concerning curricular plans, course characteristics, selection and design of instructional materials and student assessment belong to the academic departments. This means that DIL acts mainly as a support system to enable the colleges to run the courses. The main functions provided by DIL to the departments are the following: advice in the selection and design of instructional media, editing of study guides, registration of students, distribution of learning materials, collection of submitted lessons, administration of exams, return of corrected assignments, and maintenance of the supporting information system.

Table 1a

Summary of Student Variables Affecting Outcomes in Distance Education Programs

VARIABLES	RELATION TO OUTCOMES	REFERENCES
Socioeconomic background	Overall impact on scholastic factors	Alexander, 1975; Jencks and Riesman, 1967
Intelligence and abilities	Determines the amount and pace of learning	Cronbach and Snow, 1967
Academic attainment	Increases persistence and pass rate	Woodley and Parlett, 1983; Hilton, 1982
Time-on-task	Positive influence on achievement	Bloom, Hasting, and Madaus, 1981
Level of motivation	Increases persistence and completion	Schwittmann, 1982
Familiarity with content	Increases likelihood of learning	Schallert, 1982; Anderson, 1984
Cognitive study skills	Improve deep processing and recall	Marton and Svensson, 1982; Frase, 1973
Orientations to study	Intrinsic orientation leads to better skills	Marton and Svensson, 1982; Marland, 1984
Age of the student	Motivation increases, performance decreases	James, 1984

Table 1b

Summary of Instructional Material Variables Affecting Outcomes in Distance Education Programs

VARIABLES	RELATION TO OUTCOMES	REFERENCES
Advance Organizers	Facilitate cognitive organization	Ausubel and Robinson, 1969
Overviews and summaries	Facilitate cognitive organization	Marland and Store, 1982
Statement of objectives	Help hierarchize and select information	Marland and Store, 1982
Vocabulary aids	Help identify the "deep structure"	Stahl, 1983
Verbal redundancy	Facilitate grasping of key ideas	Gagnè, 1978
Staging devices	Facilitate access to the "deep structure"	McConkie, 1977; Pichè & Slater, 1983
Adjunct aids	Provide opportunities for rehearsal	Rothkopf, 1982
Adjunct questions	Provide opportunities for rehearsal	Rothkopf, 1982
Structured tasks	Intense rehearsal and concept organization	Rothkopf, 1982; McConkie, 1977
Graphic aids	Help identify the "deep structure"	Macdonald-Ross, 1977
Study directions	Help develop study skills	Anderson and Armbuster, 1982
Typographical cues	Guide attention to conceptual structure	Hartley and Brunill, 1977
Course workload	If high, caused drop-out and lower grades	Woodley and Parlett, 1982
Variety of media	Increases achievement, reduces drop-out	Bates, 1976; Schramm, 1977
Course age	Negative impact on completion and pass	Woodley and Parlett, 1982

Table 1c

Summary of Institutional Support Variables Affecting Outcomes of Distance Education Programs

VARIABLES	RELATION TO OUTCOMES	REFERENCES
Summer schools	High positive impact on achievement	Woodley and Parlett, 1982
Number of enrollments	Tends to increase rate of drop-out	Woodley and Parlett, 1982
Frequency of contacts	Positive effect on achievement	Holmberg, 1982
Speed of turn-around	Positive effect on completion	Holmberg, 1982
Assessment-centered advising	Non significant or negative effect on outcomes	Holmberg, 1981
Student-centered advising	High positive effect on completion and achievement	Holmberg, 1981; Paine, 1983; Mejia, 1983

The instructional system of DIL relies mainly on printed material, as most distance education systems do. Typically, a course has a study guide and one or more textbooks. The latter are often the same ones used in class instruction, but a few of them have been especially designed for individualized learning. The study guides, mostly designed by PSU professors, present the actual structure of the course: objectives, list of lessons or administrative units of the course, reading requirements, comments about readings, and questions for submission in each lesson. This means that a course could not be administered without a study guide. The number of lessons ranges from 10 to 20 in most courses. Besides sending lessons, the students have to take official exams. These are supervised by proctors, who are not necessarily faculty persons; actually, most of them are high school teachers. DIL tries to insure by the best means the fidelity of proctors and exam conditions, but complete control is not feasible. Submitted lessons and exams are corrected by the faculty member in charge of the course; then, lessons are returned to students but exams are not. The style of correction varies greatly among professors: some of them include detailed comments and recommendations for improvement; others only indicate the grades. Students may consult professors by direct or indirect means, but are not encouraged to do that though. It is understood that they are mostly on their own.

Besides that core instructional system, some 10 percent of the courses have complementary television programs, which can be viewed through educational channels in Pennsylvania, or in selected learning resources centers. A few courses also use the computer as instructional tool, depending on local facilities.

The present study focused in DIL's credit-degree students who are enrolled in a PSU academic program. PSU norms establish that they can take no more than one DIL course per semester, but often departments give authorization for up to three courses. The typical motivation of these students for taking independent learning courses is to fill program requirements. As incentives, the DIL program charges near half the regular tuition and allows more time for completion. While a regular PSU semester is 17 weeks, DIL students have 24 weeks semesters that can be extended to 32 by asking permission. The credit group has shown a tendency to grow since 1982.

Unit of Analysis

The unit of analysis of the study is the course cohort, defined as the number of students enrolled in a course within a given academic period. The decision to adopt this unit was taken after considering two contrasting approaches on the subject. In first place, Pedhazur (1974) indicates that, in studies based on causal hypotheses, it is possible to utilize individual or group outcomes and that the resulting observations may differ. He suggests that the choice should be made on the basis of the kind of questions the study addresses and the expected utilization of results. This general principle is partially criticized by Burnstein and Miller (1981, pp. 194-224), in reference to regression-based studies of educational effects. They state that when the researcher decides to use aggregate data--for instance, when comparing the performance of several groups of students that used different methods of instruction--the between-groups variance explains only part of the effect, since some

methods tend to make the students more uniform while others make them more different.

Taking into account these contrasting points of view, it was decided to use the course cohort as the basic unit of analysis and collect additional data about individuals. The underlying rationale was, first, that the type of policies that will be addressed deal with the courses as micro-systems. Second, that the use of aggregate data allows statistical control of individual variables--such as intelligence and socio-economic status--considered as highly unalterable through program actions. Additionally, the individuals' variability within groups was used to supplement the explanation of some relationships that could not be accountable to variables at the aggregate level. Specific references will be made in the findings when conclusions are drawn from the individuals' variance.

Sample and Subsamples

As indicated above, the core research procedures in this study were regression and correlation analyses. It is known that one key condition for obtaining significant measures of association in this type of study is that the variables show good variability (Pedhazur, 1974, p.245). This condition is difficult to meet when limitations of resources make it impossible to select a large sample. In the present study, such limitations existed. To compensate these shortcomings, the sample was selected from courses that represented extreme values on criteria that were directly relevant to the study: completion rate, pass rate, quality of materials, and quality of faculty support. Thus, the variability among courses was enhanced.

The selection of course cohorts automatically determined the selection of three sub-samples: (1) the students who were active in those 25 courses during the established period, (2) the instructional materials for these courses, and (3) the instructors who were responsible for the academic activities. All these subsamples were exhaustive: in other words, it was attempted that all "individuals" in the respective populations were included in the sub-samples. The final outcome of the sampling procedures was the following:

-- 914 credit-degree students, in the students subsample;
-- 25 instructors, in the faculty subsample; and
-- 30 books and 25 study guides, in the instructional materials subsample.

Data Collection Procedures

Three different procedures were used to collect data from each sample, taking into account their unique characteristics. These procedures are described below.

Review of Available Files

The DIL program collects data about students on individual basis; each student has a folder that is constantly updated during his/her stay in the program. Folders include registration forms, grades, letters to and from the student, fee bills, copies of final exams, and so forth. In order to locate the data about the students, it was necessary to review the corresponding 914 folders. No special instruments were required, because the desired data were directly available.

Survey of Instructors

This was accomplished through a mail instrument (Appendix A). Its major purposes were to gather information about the quantity and quality of support provided by faculty to students and to know their appraisal of the learning materials used in the courses that were under their supervision. Additionally, some questions about the instructor's experience in the program were asked.

Analysis of Instructional Media

In order to obtain comparable indexes of quality in respect to the instructional media, all components in the course packages were analyzed and scored according to the evaluation criteria. This task was accomplished by the investigator with aid of an evaluator's protocol which was quite similar to the previously described instrument.

Hypotheses of the Study

General Hypothesis

As indicated in the introductory chapter the most general proposition of the study is that, in the context of distance higher education, certain measurable relationships exist among program input--i. e. characteristics of students, instructional media, and institutional support--and program output--i. e. student grades, rate of completion, and rate of pass. It is assumed that these relationships vary in importance and that that they can adopt certain sequential patterns of influence to be determined by research.

Specific Hypotheses

Hypothesis 1: The following variables are assumed to have a positive linear and statistically significant, relationship with program outcomes: previous college attainment of the students, number of completed prerequisites, time elapsed to complete, instructional quality of textbooks and study guides, variety of media, number of revisions performed on instructional material, quality of communicative support offered by instructors, and hours dedicated by them to the program.

Hypothesis 2: The following variables are assumed to have a moderately negative relationship with program outcomes: student age, course workload, course age, number of students in the cohort, and assessment-centered support offered by instructors.

Hypothesis 3: The dependent variables--completion rate, pass rate and course grade average--are highly and positively correlated among themselves because they are all indicators of achievement and depend on the same factors. Conversely, there is very low or null correlation between categories of program variables, because they tend to act as independent factors. There is moderate correlation within each category of variables due to interaction effects among these variables.

Hypothesis 4: A high proportion of the variance of the dependent variables--completion rate, grade mean, and pass rate--can be explained by regression models combining different program variables of students, instructional materials, and institutional support.

Hypothesis 5: It is possible to construct a model of structural or path influence relations among the program factors--student input, instructional materials, and institutional support--and the dependent variables--completion and achievement--that accounts for a high proportion of the variance of the former. This model would be consistent with the three-factor paradigm postulated at the onset of the study.

Operationalization of Variables

The data collection procedures allowed to measure over 30 variables for all subsamples. They are summarized in the following list that indicates the variables in the same order as referred in the review of literature. Each variable is identified with a code that will be used from now on as abbreviation of variable name. It may be observed that not all variables referenced in the literature were measured, due to resource limitations.

Dependent Variables

The basic dependent variable of the study is student achievement. This variable is usually measured through three indicators: course completion, success in terms of pass or fail, and grade. All three were used in the study and there are both individual and aggregate measures for each of them.

The individual student factors were the following:

(01) GRAD: Grade obtained by the student in a particular course under study. Grades are expressed by DIL in scores ranging theoretically from 1 to 100, but in practice from 50 to 100 because grades lower than 50 are not assigned ever. The cut-point for pass is 65.

(02) QRES: Qualitative result of the student with respect to completion. There are two possibilities: completers, or students who stayed up to the last assignment; and non-completers, or students who dropped sometime between registration and the official deadline.

(03) PROM: Promotion outcome of the student as pass or fail. These values apply only to students who remained in the course list for the full academic period. Students who officially withdrew within the first four weeks after registration are deleted from the course list and indicated here as "noshow."

The aggregate student factors were the following:

(04) MGRAD: Arithmetic mean of grades in a particular course and cohort.

(05) RCOMP: Completion rate expressed in terms of percentage of students in a cohort who returned all assignments, passing or not.

(06) RPASS: Pass rate in the course expressed as percentage of students who obtained equal or more than the minimum approval grade in a particular course and cohort.

Student Variables

(07) AATT: Previous academic attainment of the student in terms of the number of college years completed by the student prior to registration in a particular course.

(08) NPRE: Number of requisite courses completed by the student before a particular course in the sample. Requisites are based on the idea that a student needs some previous knowledge to enter a certain course. This variable is meant to be a proxy measure of previous experience or familiarity of the student with the course content, a key factor of learning.

(09) TIMEC: Time elapsed by the student to complete a course, measured in days. This is is intended to be a proxy measure of time elapsed on task, that could not be directly appraised.

(10) AGE: age of the student at the moment of registration in a course included in the sample.

Four additional aggregate variables were obtained through computation:

(11) MAATT: arithmetic mean of college year attained by students in a course cohort.
(12) MNPRE: arithmetic mean of the number of prerequistes accomplished by the student in a course cohort.
(13) MTIMC: arithmetic mean of the numbers of days used by students to complete a particular course. The students who withdrew are excluded of the computation.
(14) MAGE: arithmetic mean of student ages in a particular course cohort.

Instructional Media Variables

(15) FTXT: Instructional quality of textbook as rated by faculty; the ratings were given by instructors in charge of the courses.
(16) ETXT: Instructional quality of textbook as rated by evaluator. This is similar to the former, only the source is different.
(17) FGDE: Instructional quality of the study guide as rated by the responsible faculty member.
(18) EGDE: Instructional quality of student guide as rated by the instructor.
(19) QMAT: A summary factor, obtained by summing the values of FTXT and ETXT.
(20) FWKL: Workload of the course as appraised by faculty; this factor corresponds to an estimate of the number of hours required to complete the assignments.
(21) EWKL: This is an alternate estimate of the course work load, based on the number of pages assigned to read, the number of lesson submissions, and the number of exams. These three indicators were transformed into standardized T-scores, and then added up to form a compound score.
(22) MVAR: Variety of media in the course, as represented by the number of unique resources included in the course package; i.e., textbooks, study guide, workbook, television programs, and handouts.
(23) NSEM: Course age, as represented by the number of academic semesters in which the course has been utilized.

Institutional Support Variables

(24) FSUPP: Intensity of support provided by instructor to students, as determined by the following indicators: comments given to students in returned lessons, phone calls accepted, direct interviews, exchange of correspondence on particular problems, and suggestions for additional readings.
(25) N: Number of students registered in the course. This is assumed to act as a proxy measure of the amount of frequency of the student-tutor interaction. The more students are enrolled, the less time has the instructor to deal with their individual problems.

FINDINGS

Descriptive Overview

Student Subsample

The students in the subsample were formally registered for academic programs at PSU. They can be defined as traditional students taking some courses at-a-distance. Their average age is 22.47 and the mean of college years completed is 2.58 which places most of them at junior level or short of graduation. There are, however, near 22 percent students older than 24 who fall into the category of adult students. Proportionally, credit-degree students amount to 31 percent of total number of enrollees in DIL for the period of the study, July 1983-June 1984 (DIL, 1985, p. 5). By coincidence, the sampling rate was also 31 percent of that sub-population.

The achievement of DIL credit-degree students in the sample quite high, as evidenced by the following indicators: their completion rate is 75.38 percent their pass rate is 70.35 percent and their modal grade is 85. However, it was observed that 10 percent of the students had a grade of 50; these have been automatically failed by the system, because they did not complete their work. It is interesting to notice that this group does not significantly differ from the rest of the sample in terms individual traits. The reason for their failure must be sought in program-related factors.

The distribution of the time elapsed to complete the courses shows that this factor is critical for the distance students. Roughly 47 percent finished the courses within the normal period of 24 weeks, while 39.33 percent need an extension of 4 more weeks and 13.64 percent even more than that. This means that most distance students needed more time than the regular students to complete courses.

Faculty Subsample

The lack of response to 40 percent of the questionnaires prevents drawing generalizations about professors. However, there are two aspects that have sufficient confirmation. First, most professors did not receive specific training about how to work in a distance situation, which is a handicap to their supportive role. Effective support in distance education may be achieved through a combination of techniques such as correspondence, audiotutorials, and telephone advising, targeted comments to assignments, and grouping of students in terms of support needs. These techniques are unfamiliar to most college professors; then, some introductory training is highly recommendable. Secondly, the self-ratings of support by professors indicate that they do not communicate with students very often; out of a maximum possible score of 40 in the support subscale, professors produced a modal score of 18.

Instructional Materials Subsample

Books and study guides were evaluated according to comparable criteria of instructional presentation; i.e., use of objectives, summaries, review questions, adjunct aids, and staging techniques. Books seem to group themselves into two clearly distinct categories of high and low quality of presentation. Typically, more recently produced courses have better quality textbooks than older courses. Some of these older courses have had the same textbook for more than 10 years. The study guides have likewise trends, although less clearly differentiated

than the former. The relationship between the age of the course and the quality of guides is also evident. The more recent the study guides, the better.

It is important to connect these results with the ways in which courses have been created and revised at DIL. Before 1978, the facility could not afford to contract instructional designers; the responsibility for authorship was entirely on the departments. This process was not systematic, because most departments did not have specialized staff in the area of media. Since that year, the process has become more systematic due to the existence of a Instructional Publications unit. Course authors receive brief guidelines about what is desired in the study guides; and they have to submit a sample lesson for continuation of the production contract. This generates a more elaborated product. However, revisions of "old" materials are not subject to the same interactive process. They are typically initiated when a new edition of a textbook is issued and the study orientations have to change. If this happens, chances are that the revision will be superficial; only to accommodate the guide to the new textbook. In summary, DIL is progressively building a course subsystem that can insure increments in quality of materials, but this subsystem cannot still thoroughly process materials created in the past.

Analysis of Bivariate Relationships

Research hypotheses are grounded on the notion that real events are connected through networks of influences. However, these networks can be envisioned only after a good number of bivariate relationships are clearly established. Relations of the type "if A increases then B increases" or "if A increases then B decreases" are the core of comprehensive models involving multiple variables. For this reason, it is convenient to explore to what extent the independent variables of the study are connected to the outcome variables and among themselves. The following analyses are based on the set of variables whose descriptive statistics are compiled in Table 2.

Relations Between Individual Variables and Outcomes

The "classic" individual variables did not show a good degree of association with course outcomes. This is true for both individual and aggregate data. In the correlation matrix of individual data versus grades (Table 3), it can be seen that there is no correlation between college attainment (AATT), number of prerequisites completed (NPRE), and student age (AGE)--on one hand--and grades--on the other. At the level of aggregate data (Table 4), only the mean of ages by course cohort (MAGE) shows a slight positive correlation with grades (.23), but it is not significant.

By contrast, the time elapsed to complete courses (MTIMC) is negatively related to RCOMP (-.39), which indicates that when students take longer to finish a course there are more drop outs. This is indicative of the fact that MTIMC may not reflect the individual time-on-task, that has a positive relationship with completion, but rather the degree of difficulty experienced by students. If this is true, MTIMC would be a mediating variable instead of an individual factor, because course difficulty results from the interaction between students and learning conditions.

Table 2

Descriptive Statistics of Aggregate Variables for 25 Courses

VARIABLE	MEAN	ST. DEV.	MINIMUM	MAXIMUM
Student Variables				
MAATT	2.71	0.54	0.86	3.55
MNPRE	0.48	0.69	0.00	2.88
MAGE	23.24	2.53	20.57	29.77
MTIMC	181.70	34.63	102.50	242.94
RCOMP	76.55	13.38	44.00	96.88
MGRAD	80.57	6.46	65.88	91.57
RPASS	71.35	20.92	18.18	96.88
Support Variables				
N	36.56	49.17	8.00	242.00
FSUPP	21.03	3.74	14.00	29.00
Media Variables				
FTXT	36.36	5.72	26.00	49.00
ETXT	29.76	9.25	13.00	45.00
FGDE	36.79	7.55	22.00	47.00
EGDE	25.84	8.39	12.00	42.00
QMAT	55.60	14.63	34.00	82.00
EWKL	150.00	19.93	116.17	187.87
MVAR	1.72	1.06	1.00	4.00
NSEM	15.36	11.81	3.00	39.00
NEDIT	1.96	1.14	1.00	5.00

Table 3

Correlations Among Individual Student Variables

PEARSON CORRELATION COEFFICIENTS / NUMBER OF OBSERVATIONS

	AATT	NPRE	AGE	TIMEC	GRAD
AATT	1.000	0.135**	0.179**	0.025	0.038
	914	914	914	689	768
NPRE		1.000	0.025	-0.003	0.051
		914	914	689	768
AGE			1.000	-0.058	-0.004
			914	689	768
TIMEC				1.000	-0.090*
				689	689

Note. * Significant at p<.05 ** Significant at p<.001

Table 4

General Correlation Table Among Selected Variables

	N	MAGE	MAATT	MNPRE	MTIMC	NSEM	MVAR	ETXT	EGDE
N	1.000	-0.235	-0.185	0.089	0.332	0.412*	-0.182	0.071	0.385*
MAGE		1.000	0.193	-0.094	-0.205	-0.105	-0.193	-0.304	-0.223
MAATT			1.000	0.235	-0.109	0.112	-0.338	-0.332	-0.060
MNPRE				1.000	0.067	0.158	-0.123	0.093	0.282
MTIMC					1.000	0.262	-0.371	-0.170	0.112
NSEM						1.000	-0.520*	-0.118	0.018
MVAR							1.000	0.426*	0.280
ETXT								1.000	0.374
EGDE									1.000

	QMAT	EWKL	NEDIT	FSUPP	RCOMP	RPASS	MGRAD
N	0.265	-0.169	0.62**	0.107	-0.067	-0.037	-0.092
MAGE	-0.320	-0.247	-0.306	-0.323	0.149	0.189	0.231
MAATT	-0.244	0.104	-0.073	0.174	-0.032	-0.046	0.012
MNPRE	0.221	0.245	0.015	0.045	0.098	0.062	0.012
MTIMC	-0.043	0.276	0.343	0.240	-0.397*	-0.177	-0.200
NSEM	-0.064	0.179	0.75**	0.012	-0.190	-0.375	-0.178
MVAR	0.430*	0.040	-0.321	0.132	0.022	0.164	0.074
ETXT	0.84**	-0.080	0.134	-0.075	0.255	0.275	0.149
EGDE	0.81**	-0.090	0.187	0.466*	-0.131	0.008	-0.179
QMAT	1.000	-0.102	0.192	0.220	0.086	0.179	-0.009
EWKL		1.000	0.216	-0.005	-0.154	-0.105	0.001
NEDIT			1.000	0.056	-0.177	-0.303	-0.311
FSUPP				1.000	-0.542	-0.524	-0.686
RCOMP					1.000	0.83**	0.623**
RPASS						1.000	0.827**
MGRAD							1.000

Note. * Significant at p<.05 ** Significant at p<.001

Relationships Among Institutional Support Variables and Outcomes

One surprising finding of the study is that faculty support (FSUPP) is negatively correlated with the three indicators of outcomes; the respective coefficients are: -.54 for RCOMP, -.68 for MGRAD, and -.52 for RPASS (Table 4). All these indexes are highly significant. This could be read as suggesting that the more professors communicate with students, the poorer is the output of students in courses; but that would contradict most evidence on the subject. There is an alternate explanation that seems more plausible, and it is related to the distinction established by Holmberg (1981) between forms of distance advising. Basically, there are two approaches to advising: one centered in the mechanics of assessment, and the other centered in the student. Research in distance education tends to focus on the second in order to clarify the attitudes, resources, and techniques that characterize good tutoring in distance systems. The assessment approach can be considered as reactive instead of planned or proactive, because it depends essentially on the number of assignments that have to be at a given time. This approach has received very little attention in research, although it may be predominant in many institutions offering distance education as a kind of supplement to their major mission. Professors who work under these conditions do not seek actively to promote learning in students; rather, they expect the students to work largely on their own. Communications are very infrequent and, if they occur, they are often initiated by problems experienced by the students; i. e. lack of understanding of certain topics, insufficient orientation about assignments, and incongruities among the assignments and the learning materials. The more frequent these problems, the higher the solicitation of help by students.

The former explanation seems to fit better into the data of the study than the idea of faculty support being harmful to outcomes. Some additional evidences serve as corroboration. It is observed (Table 4) that the time elapsed to complete (MTIMC) is positively correlated with the number of students enrolled (N) and with faculty support (FSUPP); r=.33 and r=.24, respectively. It can be interpreted that as the number of students increases, also increases the number of lessons to process and the number of individual inquiries; then professors take longer to return lessons and correspondence, which, in turn, causes that students take longer to finish a course. This issue will be discussed later in more detail in the light of the emerging path model of distance programs.

Relations Between Instructional Material Variables and Outcomes

The media factors do not not show a dramatic association with outcome variables. However, there are cues of a pattern that can be interpreted within the theoretical framework of the study. First, as seen again in Table 4, quality of textbooks (ETXT) shows direct correlations with both RCOMP (.25) and RPASS (.27). Secondly, variety of media (MVAR) correlates -.37 with time elapsed to complete (MTIMC), which indicates that the higher the variety of media the shorter the time elapsed. This is a positive effect on difficulty. Finally, on the negative side, the age of the course (NSEM) tends to reduce RPASS, the correlation is -.37, and an increase MTIMC or difficulty, correlation is .34. All these coefficients are not significant if one applies the probability .05 criterion, but they are conceptually coherent.

The former evidence, even though small, supports the idea that good quality materials contribute effectively to save learning time to students and to promote their academic success. Better quality of materials is most likely found in recently produced DIL courses because, as it was already indicated, professors have received specialized advice in design during the last few years. Furthermore, old courses are not easily improved through revisions because the changes are often aimed to superficial aspects. The reactions of students are not systematically collected to enlighten such decisions. It is baffling to know that the number of revisions of study guides (NEDIT) is negatively correlated with all indicators of outcomes: -.17 with RCOMP, -.31 with MGRAD and -.30 with RPASS; and it is positively correlated with MTIMC (.34). In conclusion, revisions are not effective in reducing learning difficulties, in the current context of DIL.

Evaluation of Hypotheses 1, 2, and 3

By considering the former results altogether, it can be stated that hypotheses 1, 2, and 3 are partially supported by evidences, despite the lack of dramatic proof of direct relationships. Hypothesis 1 has been particularly confirmed with respect to the media variables ETXT and MVAR. It is not confirmed in respect to the influence of the individual variables MAATT, NPRE, and MTIMC. The latter deserves special attention, because it has been suggested that MTIMC might be rather an indicator of course difficulty than a measure of the time elapsed on task. With respect to faculty support, it can be simply said that the student tutorial--in the sense that it is defined in current distance programs--has not been developed yet by the program under study. Therefore, the impact of this factor on outcomes cannot be properly appraised. It seems that reactive support is predominant, and it increases or decreases as a function of the number of assignments that each instructor has to process and the number of requests coming from students.

Hypothesis 2, referred to the factors that have negative impact on outcomes, has near complete verification. Course workload, course age, number of students in the cohort, and assessment-centered support correlate negatively with at least one indicator of outcomes. Actually, the student age was not a meaningful variable in the present study, because the majority of the sample was within traditional age standards for college students.

Hypothesis 3 is fundamentally important for the regression and causal analyses. It simply establishes that the independent variables are not highly correlated among themselves; in other words, there is no multicollinearity among them and they can be used to predict the dependent variables that, in turn, are highly correlated. Both aspects are supported by the correlation matrix presented in Table 4. It can be observed that, except for the correlations among the dependent variables, the coefficient tend to be moderate or low. It is worth to mention here two caveats that have to be taken into account in interpreting these results. In the first place, QMAT must not be included in the bivariate analysis because it is actually a composite of ETXT plus EGDE used for computing the combined impact of print materials on outcomes. Secondly, MGRAD and RPASS are one single variable measured in two different ways, inasmuch the decision of assigning a pass or fail

is made on the basis of grades. However, RPASS reflects better than MGRAD the degree of success of student cohorts because it tells exactly what proportion of them were promoted either to a degree or to the next level of instruction.

Some other important correlations, although not specifically mentioned in hypotheses, are (Table 4): NEDIT vs. N (.61), NSEM vs. N (.41), NSEM vs. NEDIT (.75), and NSEM vs. MVAR (-.51). They all reflect the importance of course age as an explanatory factor. Older courses have had more revisions, but the variety of media has not been increased. Also, more students tend to register in older courses, since these courses are required by several programs; which explains why they remain for so many years.

Regression Analysis: Submodels

Because of the considerable number of variables involved and the need to carefully test all relationships for statistical significance, it was decided to work with small groups of interrelated variables and, after building regression models for each sub-group, to integrate all them in a final path model encompassing the most important factors in distance education programs. The process of model construction was partly theoretical and partly statistical. Theory provided "hints" about what variables should be tested in models, and the general linear model procedure was used to check the goodness of fit. Several models were rejected and the final set represents a compromise between theoretical meaning and statistical validity.

Submodel 1: RPASS

In the final model encountered for this dependent variable, RPASS is a reflection--on one hand--of the positive influence of the quality of materials, the time elapsed to complete, and the rate of completion; and--on the other--of the negative influence of reactive faculty support and age of the course. These variables yield a high coefficient of determination of .81, significant at .0001. All predictors are significant at .15 or below.

An inspection of the (standardized) beta coefficients of Submodel 1 indicates that RPASS could be considerably increased, if the negative impact of FSUPP and NSEM were slightly reduced. In other words, if faculty support were more active and some old courses were substantially revised, the already high rate of pass would approach 100 percent.

Submodel 2: RCOMP

The rate of student persistence in the courses was a kind of problematic variable, because it was not found a predictor that produced significant positive loadings on it. There is a small positive beta coefficient from QMAT(.18), but it was not included because it was not significant. Both causal factors in the model--MTIMC and FSUPP--have a negative influence; the latter accounting for almost 50 percent of the variance (Table 5). This means that the explanation for persistence must be sought in different causal sources. One possible factor, stressed in a number of studies by Astin (1975) is the intensity of involvement of the student in academic life, which is not easy to measure in distance students.

At least one positive contribution of this submodel is that it identifies two major causes of attrition, the opposite of completion.

They are mostly the excessive workload of some courses and the assessment-centered approach of professors. When a student is confronted with a long list of assignments and a distance instructor that does not initiate dialog, there is a high probability that he or she will drop.

Submodel 3: MTIMC

According to this sub-model the time elapsed to complete is a direct function of number of students enrolled, workload of the course, and reactive support by faculty. If one or more these variables increases, MTIMC would also increase. However, there is one variable with negative effect in the model: MVAR. If the variability of media increases, MTIMC would be reduced. This model has a R^2 of .39, significant at .034 probability and the predictors are significant at .16 or below.

These results lead to three important conclusions. First, MTIMC can be interpreted as a measure of the of course difficulty rather than an indicator of the time on task, because it increases proportionally to increments in factors that are known to cause problems to the students: high number of enrollments, high workload, and assessment-centered support. Secondly, the variety of media does not create burden to the student but actually reduces difficulty. It must be noticed that such variety was linked mostly to the use of a workbook to accompany the course textbook and study guide. Finally, as MTIMC is a predictor of the dependent variables RCOMP and RPASS, it can be used as mediator variable in the final model; a sort of linking factor that helps explain the apparently anomalous effect of FSUPP, and the relative importance of N, MVAR, and EWKL. These three variables do not appear in the models for RCOMP and RPASS, but they indirectly influence these outcome variables by reducing (MVAR) or increasing (N,EWKL) course difficulty.

Submodel 4: MVAR

The model for MVAR includes QMAT as a positive factor and NSEM as negative factor. The coefficient of determination is .42, significant at probability .002. Both predictors are highly significant, at .02 and .005, respectively and they confirm relationships that were observed in the bivariate analysis; namely, that the quality of printed materials is positively associated with MVAR, and negatively with the age of the course. Speaking in more concrete terms, one could say that good college textbooks are often accompanied by workbooks or other additional material, and that the quality of textbooks has increased in recent years. These phenomena can be explained by the impact of educational technology in the publishing world. It can be observed too, that it is easier to produce a good study guide from a textbook that relies on techniques instructional presentation than from one that relies basically on subject matter structure.

Submodel 5: FSUPP

The construction of this model presented more difficulties than any other. Apparently, the source of problem is that FSUPP has a relatively high correlation with MGRAD (-.68). Therefore, it was not possible to find a reasonable goodness of fit in any model, unless than MGRAD were included. This led to analysis why FSUPP should have a high and negative relation with MGRAD. A plausible interpretation within the theoretical context of the study is that professors attempt to provide more support as they observe that the grades of the cohort are poor. The grade of a student in a DIL course is not a final event, as pass or fail

are. Instead, grades are the product of accumulated partial grades in lessons and exams. There are up to 28 opportunities for partial grades in the sampled courses. It may be inferred that, with these partial grades, instructors have sufficient information to determine beforehand the range of success of a cohort. They will remain unconcerned, if grades are going well; but will intensify the attempts to provide help, if grades are going poorly.

On the basis of this rationale, the best model found for FSUPP includes: QMAT, with a positive and small influence; MAGE, with an also small but negative influence; and MGRAD, with a large and negative influence. The coefficient of determination is .52, which is highly significant at .001, as well as the predictors. This indicates that the quality of materials somehow facilitates the support that professors can offer to problems of the students; older students--it must be remembered that MAGE stands for the cohort's age mean--ask for less help than younger students; and the lower the grades the more intense the reactive support offered by instructors.

Evaluation of Hypothesis 4

The former discussion provides sufficient evidence to establish that the variance of outcomes can be explained by the combined effect of individual, media, and support variables. Furthermore, the set of predictors is quite consistent through all models; they are only seven variables: NSEM, EDGE, QMAT, MTIMC, FSUPP, MVAR, and MAATT. The respective models are coherent with theory and research on distance education, if the alternate explanation for FSUPP is accepted as valid in this particular case. There is still a question about the statistical power of the models, because in any instance the R^2 was very high. However, this is rather difficult to find in the context of educational research, because there are many other variables involved in large-scale programs that cannot be measured. At least, the models present sufficient evidence that these 7 independent variables explain between 37 to 57 of the dependent variables variance. An appropriate measure of the magnitude of that relation are the multiple correlation coefficients, or square roots of the coefficients of determination. They are: RCOMP=.60, MGRAD=.75, and RPASS=.71.

Final Causal Analysis

One of the requisites of path analysis is that causal relations are established in one single direction, which means that interaction effects are ruled out. This is done to preserve the recursive character of the model, that allows one to calculate the amount of direct and indirect influence that the independent variables load on the dependent, by tracing back the appropriate "paths" from the latter. A non-recursive model would present the problem that at a given point a variable is both cause and effect of another, then their coefficients of determination cannot be interpreted. There are other methods apt to deal with this kind of model, but these are beyond the scope of this analysis.

The point of the previous remark is that, if causality is interpreted as uni-directional, there must be one ultimate dependent variable that stays at the end of the causal sequences in the model. As there were three measures standing for dependent variables--completion, grades, and pass rate--it was necessary to make a choice. Completion did not represent a problem, because a student clearly completes a course

before having the final grade. The other two, however, occur simultaneously. After weighting a number of reasons, it was decided to use pass rate as the final result of the path model. It was taken into consideration that the key indicator of success for a course cohort is pass rate, not grades. RPASS indicates the final decision of promoting or not promoting students, while grades are mostly indicators of individual achievement. They do not have a clear meaning when grouped; two cohorts can have the same grade average and their promotion results be completely different.

The analysis, to this point, has produced five submodels with relatively good coefficients and statistical significance. These include 11 variables apparently inter-related. In order to integrate them in a recursive path model it was first necessary to postulate a causal ordering of the variables. The main criterion for specifying causality is temporal sequence, because it is known that one causal factor cannot go after the event that it is supposed to cause. Following this indication of temporal priority, the model shown in Figure 2 was obtained. It represents the most complex construct derived from the study. To explain it is equivalent to summarize the findings in a more abstract form.

For a correct interpretation of the model, it is necessary to briefly review some of the rationale of path analysis (Asher, 1983). First, it is prescribed that causal order must be read from left to right. The circles represent variables and the straight-line arrows causal "paths." Variables are classified as exogenous to the model when they only emit arrows; and endogenous when they receive arrows, independently of whether they emit or not. A compound path is formed by all variables connected by arrows that stand between any of the variables and the ultimate dependent, always following the sequence from left to right. Each arrow has a value corresponding to the beta or path coefficient of the source variable on the destination variable. As the variables were previously standardized to z-scores, with a mean of 0 and a standard deviation of 1, these betas are comparable. They indicate the direction (+ or -) and magnitude of influence of a variable on another; the closer its value to the unit, the higher the influence.

Secondly, according to the method described by Pedhazur (1982, pp. 588-593), path coefficients allow to calculate the direct and indirect influence of a given independent variable on the dependent variable, because it is assumed that each path represents a regression equation of the form:

$$Y = a + b_1X_1 + b_2X_2 + \ldots + b_kX_k$$

The direct influence is equal to the simple path between both variables, if there is one. The indirect influence is calculated, on the basis of the former equation, by finding all paths between the chosen pair of variables, multiplying the betas in each path, and adding up the products of all compound paths. Then, the total influence of a variable on another is the sum of direct plus indirect paths. If the path model is based on well grounded hypotheses, this total influence should equal the correlation coefficient between both variables; that is, the measure of maximum association existing between them. However, not all compound

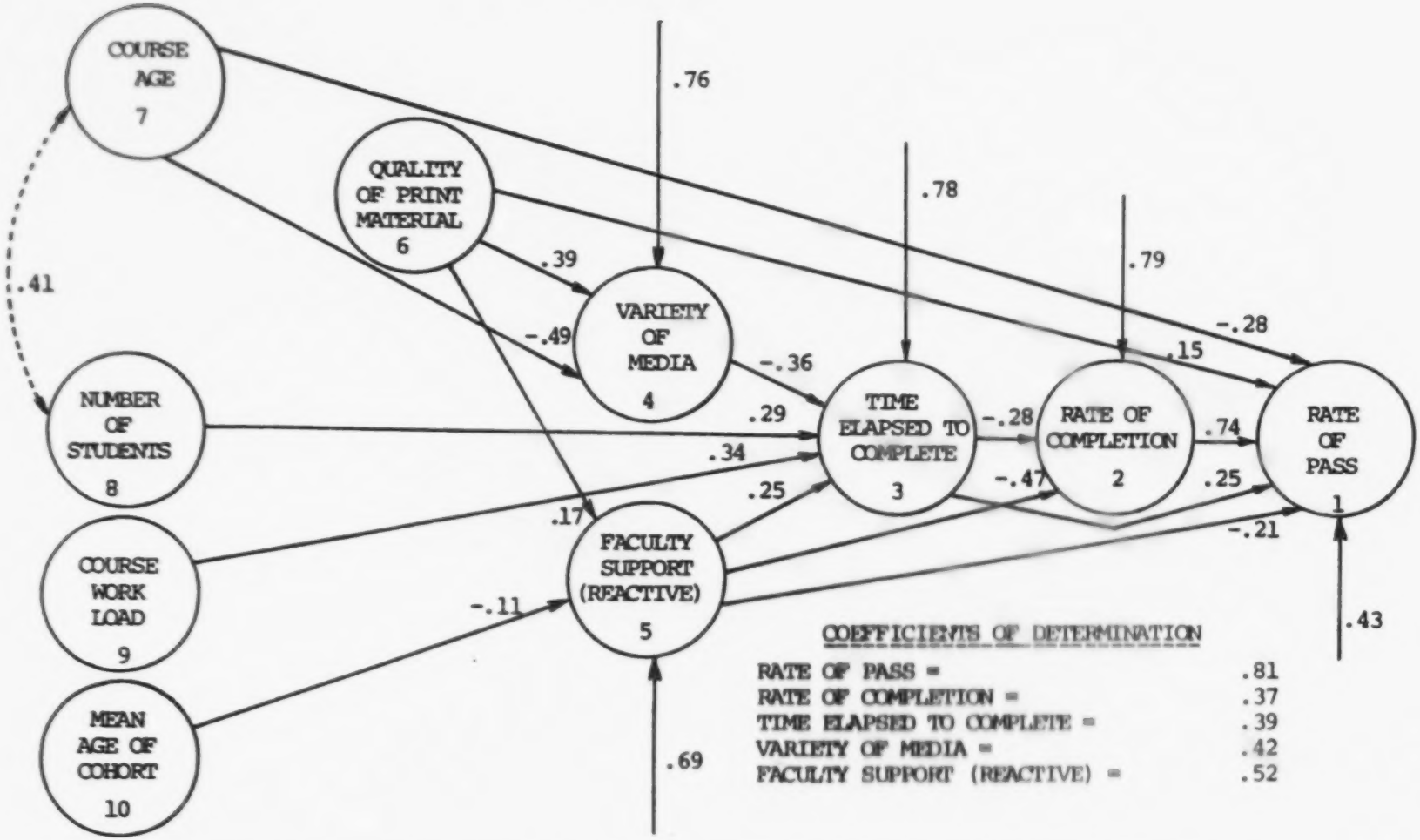


Figure 2. Final Path Model of Distance Education Course Outcomes (Standardized Variables)

Note. Beta coefficients are significant at .16 or below and R^2 are significant at .03 or below.

paths are interpretable as implying indirect causal effects. In the end, one has to rely for interpretation on the hypotheses behind the model.

Finally, the vertical arrows pointing to endogenous variables indicate unknown or error factors; they are equivalent to the square root of the unit minus the R^2 of the respective submodel. The magnitude of unknown influences may cause that a path is not interpretable. The only curved line indicates the direct correlation coefficient between two exogenous variables, NSEM and N, which is not included as part causal interpretation but only as a measure of association.

Going back to the model, the pass rate in the course cohorts is a product of the joint action of the course age, the quality of printed materials, the reactive support by the instructor, the time elapsed by the students in academic work, and their persistence towards completion; the latter being by far the most influential factor. It has been indicated that the average college attainment of the cohort is also an influential factor, but its impact is so low that in the model is subsumed into error variance.

There are two factors that seem to have negative impact on pass rate: the age of the course, and the intensity of support provided by instructors. The negative impact of course age is explained by the fact that older courses have lower quality materials. The second result is intriguing; however, it can be attributed to the fact that instructors, as a rule, do not plan to provide aid to students; they rather react to problems presented by them. Thus, the higher the amount of difficulty experienced by students in the course, the higher the frequency of reactive support.

Persistence of the students towards completion is also affected negatively by this kind of reactive support and by the difficulty of the course, as reflected by the average time elapsed to complete. Of these two causal factors, reactive support has the most decisive (negative) influence. On the other hand, there are indications that the influence of the time elapsed (difficulty) on completion is not linear. It seems that there is a certain optimum range of course assignments in terms of readings, lesson submissions, and exams. When this range is surpassed, the time elapsed for completion becomes longer and the attrition rate increases.

The quality of textbooks and study guides, grouped in the model under the title of "quality of print material," are important determinants of achievement, as measured by grades and pass rate. Better books and guides, can slightly increase the rate of pass and the amount of support provided by instructors; and, in a higher degree, influence the variety of media that is an important factor in reducing the time elapsed to complete. This is, then, a multi-causal factor that must be regarded as a key to improve performance of distance education programs.

Another key factor is faculty support, that influences the time elapsed to complete, the rate of completion, and the rate of pass. It turns to be that, in the program under consideration, this support is mostly reactive to problems experienced by the students. Then, it shows

negative impact on all formerly mentioned variables: it contributes to moderately increase the time to complete, greatly reduce the rate of completion, and moderately bring down the rate of pass. It would be expected that, if the system used some kind of planned and communicative support--although indirect--this factor would turn to exert positive impact on all three variables.

The average time elapsed to complete a course in a cohort is a central mediator variable in the model and, as it was indicated, it is probably related to the difficulty level of the course. This variable is affected positively by the variety of materials additional to the textbook available to the student; i.e., workbook, television programs. These elements actually reduce difficulty quite substantially. However, this effect may be counterbalanced by three variables that contribute to increase the time elapsed to complete: reactive faculty support, as discussed; number of students enrolled in the course; and course work load, in terms of the net amount of assignments. Of these three, it seems that workload is the most closely related to difficulty, and the others are associated factors. Indeed, the larger the number of students in a course, the more support is requested.

The individual characteristics of the students at the point of beginning distance courses--i.e., age, gender, previous attainment, prerequisites accomplished--seem to have little explanatory function in the model. Of these variables, it was possible to find only slight positive influences of gender and attainment on rate of pass; but they are not included in the final model because they do not meet more rigorous significance criteria. The mean age of cohort has a tenuous but significant influence on support, meaning that older students tend to require less aid from instructors.

It is striking that academic attainment and prerequisites have a negligible impact on achievement in ILS courses, as compared to the impact that these factors have on traditional courses. One possible explanation is that, due to curricular constraints, the students with less experience in college are taking basic courses which, in turn, are older and have materials of lower quality. This is supported by the relatively high association between course age and number of students, in addition to the known influence of course age.

Evaluation of Hypothesis 5

The statistical proof of this hypothesis is more complex than the preceding ones, due to the number of variables and submodels involved. It is impossible to generate a significance tests in which all variables and relations are tested for significance. For that reason, the analyses that will be presented here have only a partial value, and they refer only to the most salient aspects of the model. There are three standard procedures of verification of relationships that can be applied here: the evaluation of the coefficients of determination in the submodels, the analysis of prediction errors, and the decomposition of correlation coefficients.

With respect to the first criterion, the key issue is to determine what proportion of the variance of the dependent variables is explained by the predictors. This proportion is expressed in the coefficient of

determination (Achen, 1983, p. 58). It may be observed in Figure 2 that only the rate of pass can be accounted in a high proportion to the predictors. The other three variables that work as dependent and independent in the model have moderate indexes; which means that there are factors not considered in the model having a more substantial influence on these variables. They are indicated by the vertical arrows.

In the second place, the data for analyzing prediction errors of the models are summarized in Table 5. This table is a compendium of error measures calculated through the Procedure General Linear Model (GLM) of SAS statistical package for each one of the submodels. The table compares the F-ratios, obtained from dividing the model variances by the error variances, with the F values requested by statistical tables. It may be observed that all models are significant at different probability levels; RPASS having the most significant model. This indicates that prediction error is not a concern with respect to the submodels; they are fairly accurate. Additional support to this proposition is found after an exam of the standard errors of estimate of the predictors in all submodels. In general, these indexes are between 10 percent and 18 percent of the correspondent standard deviation of the correspondent variables; which is quite tolerable.

The final test is critical for the path model, because it is used to validate the structural connections established among the submodels. According to a previous discussion, the purpose of the test is to reproduce the simple correlation coefficients by means of the direct and indirect paths. Only three relationships were selected for testing, since they presented interesting combined paths. They are listed here with their correlations: RPASS*NSEM (-.37), RPASS*QMAT (.17), and RPASS*FSUPP (-.52). The decomposition of the correlations is presented in Table 6. It will be observed that the attempt of reproducing the correlations was quite successful although not exact for the former two. The relationship between rate of pass and course age must have some other intervening path that accounts for the difference of -.10 between the original and the compound correlation.

The examination of the final model and validation procedures allows to establish that this path structure corroborates the basic notion of Hypothesis 5; that distance education outcomes are mostly a reflection of certain factors of the instructional materials, the institutional support, and the student. There are still two major conditions to this statement. First, the terms indicating causal influences are used here only within the context of the samples and the measurement procedures of the present study. It is possible that if a similar study were conducted in other setting with other measures, different findings would emerge. Second, the student factors seem to have much less influence within the referred context than the other two types of factors. Nevertheless, it might happen that the motivation of the student--a variable not directly measured--would play an important role in persistence towards completion, which is the most important predictor of rate of pass. This is a question open to future research.

Table 5

Predictor Errors for Path Submodels (Standardized Variables)

VAR	MDF	EDF	MSQM	MSQR	F-ratio	PROB	F-min	SIGNIFICANCE
RPASS	5	19	3.928	0.229	= 17.12	.001	6.61	very high
RCOMP	2	22	4.431	0.688	= 6.44	.05	3.44	moderate
MTIMC	4	20	2.346	0.730	= 3.21	.05	2.87	moderate
MVAR	2	22	5.136	0.623	= 8.23	.01	5.72	high
FSUPP	3	21	4.221	0.539	= 7.82	.01	4.87	high

Note. Meaning of the abbreviated terms:
VAR=Dependent variable of model
MDF=Degrees of freedom of model
EDF=Degrees of freedom of error
MSQM=Mean of squares of model
MSQR=Mean of squares of residuals
PROB=Probability level of test
F-min=Minimum F required by table

Table 6

Decomposition of Selected Correlation Coefficients Through Compound Paths

BIVARIATE RELATION	CORR. (A)	CAUSAL INFLUENCE: DIRECT (B)	INDIRECT (C)	TOTAL (D) B+C	DIFFER. (E) |A|-D
X_1, X_7 RPASS vs. NSEM	$r_{1.7}$	$[b_{1.7}+$	$+b_{4.7}(b_{3.4})(b_{2.3})(b_{1.2})$ $+b_{4.7}(b_{3.4})(b_{1.3})]$		
	-.37	[-.28+	+(-.49)(-.36)(-.28)(.74) +(-.49)(-.36)(.25)]	= -.27	-.10
X_1, X_6 RPASS vs. QMAT	$r_{1.6}$	$[b_{1.6}+$	$+b_{4.6}(b_{3.4})(b_{2.3})(b_{1.2})$ $+b_{4.6}(b_{3.4})(b_{1.3})$ $+b_{5.6}(b_{3.5})(b_{2.3})(b_{1.2})$ $+b_{5.6}(b_{3.5})(b_{1.3})$ $+b_{5.6}(b_{2.5})(b_{1.2})$ $+b_{5.6}(b_{1.5})]$		
	.17	[.15+	+.39(-.36)(-.28)(.74) +.39(-.36)(.25) +.17(.25)(-.28)(.74) +.17(.25)(.25) +.17(-.47)(.74) +.17(-.21)]	= .11	.06
X_1.X_5 RPASS vs. FSUPP	$r_{1.5}$	$[b_{1.5}+$	$+b_{3.5}(b_{2.3})(b_{1.2})$ $+b_{3.5}(b_{1.3})$ $+b_{2.5}(b_{1.2})]$		
	-.52	[-.21+	+.25(-.28)(.74) +.25(.25) +(-.47)(.74)]	= -.54	-.02

Note. The numbers in sub-indexes represent the variables in Figure 2.

CONCLUSIONS AND RECOMMENDATIONS

This study explored the determinants of completion and achievement in distance education courses and their patterns of influence; this inquiry involved a process of determining significant bivariate relationships, grouping interrelated variables into regression models, and finally connecting a set of conceptually interpretable and statistically valid models into a global path construct. The findings indicate that the most important variables in determining outcomes in this setting are those related with the quality of instructional materials, the institutional support provided to the students, and the persistence of the student towards completion; other individual characteristics of the students, such as attainment, age, and gender seem to have a minor although not negligible role. The present chapter is aimed to discuss the broader implications of these findings for the theory, practice, and research on distance education. The structure of the chapter is a product of two modes of analysis that were considered. It was attempted first to answer a number of research questions referred to the purposes and methodology of the study. This may be called the internal or convergent mode of analysis, because it reflects the rationale of the inquiry. The second mode, or divergent, looked at connections with other fields of study and implications for future research in the field.

Review of Research Questions

Question No. 1:

Do the variables included in the model constitute a good representation of the program under study?

The final model (Fig. 2) of distance course outcomes includes only 10 variables, out of 30 that were measured and some 35 that were pointed out in the review of literature. So, it is a highly condensed model that is still able to explain 81 percent of the variance in pass rate of course cohorts. However, some conditions have to be put to the actual explanatory power of the model. First, it includes rate of completion as one of the mediator variables, which stands there for persistence of the student. Completion is not properly a mediator variable because it is measured at the same time that the dependent variable; pass rate. It would be convenient to have another indicator of perseverance measured some time before completion. For instance, Schwittmann (1982) used a questionnaire in which entering students were asked about their motives to participate in a distance course and their willingness to persevere up to the end despite difficulties that could emerge. An alternative measure that does not require an interrogation of students is the rate of submission of assignments, because there is a good correlation between speed of submission and completion (Holmberg, 1981, pp. 87-88). When submissions start to be too far apart it is likely that the student will drop.

Secondly, it was indicated elsewhere that the partial grades of the students could be a good predictor of the intensity of reactive support by the instructors. Unfortunately, these data were not recorded. They are not difficult to collect though, since most distance education programs require the instructors to provide partial scores as well as final scores.

In the third place, it was observed that the procedure of decomposition of the correlation coefficients (Table 6) did not satisfactorily account for the negative effect of course age on rate of pass. It was suggested that there must be another intervening variable that was not included. This variable may be the "mechanization" of the correction of assignments, as suggested by Woodley and Parlett (1982, p. 15-16). To measure this variable, it would be necessary to look at samples of lessons corrected by several instructors and determine appropriate indicators of an impersonal style of correction as opposite to a supportive style.

Finally, it must be emphasized that the advisory or tutorial component of distance education is only incipient in the DIL program of PSU. Therefore, some factors related to it--i.e., the style of advisory and follow-up of students were not used as variables in the model. Any other study developed in a different context, where tutors actually have a counseling role, should use these kind of variables in the analysis.

Beyond these four conditions, there is always the opportunity of improving a model by adding new variables or restating some of them. Nevertheless, care should be taken of not adding so much complexity that it becomes useless for educators, or its statistical power is reduced by the effect of too many predictors and relationships.

Question No. 2:

What pattern of relationships among variables emerges from the data in the study? Do these relationships contribute to validate or refute theoretical formulations that explain distance education outcomes?

To answer these complementary questions, it is necessary to temporarily suspend a restriction derived from the path analysis method and imposed on the final model of course outcomes. This restriction refers to the unidirectional causality or avoidance of interaction effects. The purpose of this restriction is to make possible the calculation of compound paths. It is known that these compound paths depend on the data that were collected for the study. Still, one may assume that the model of the study is only a particular case of a more general model, applicable to similar programs. Then, the first question above can be rephrased: What kind of pattern of relationships may be tenable for distance education programs in general? This question leads directly to the theoretical implications of the study.

Speaking in general terms, the model suggests that two key intervening variables regulate the outcomes of distance courses: course difficulty (MTIMC) and student perseverance or persistence (RCOMP). Both variables point to relations between the learner, the learning materials, and support. They cannot be defined as dimensions of one single set of variables. It is tenable to assume that these two variables interact, they affect each other. A certain degree of difficulty stimulates persistence but, after a tolerance point, the effect becomes negative. This was observed in the curvilinear relationship among MTIMC and RCOMP. On the other hand, the students who persist can progressively reduce the difficulty of the course and pass. This also explains the positive relationship between MTIMC and RPASS.

The remaining independent variables in the model will be seen as exogenous, because they depend on factors that are external to the courses. They may be correlated sometimes, because these external factors can be common to two or more exogenous variables. These exogenous variables affect achievement in distance courses, which involves both grades and pass rate, through the above mentioned mediator variables. The generalized model will look then as depicted in Figure 3. It can be seen that reactive support, academic load of the instructor (due to number of students), and course workload tend to increase difficulty; while proactive support (almost absent in DIL), quality of print materials, and variety of media facilitate perseverance. As the two moderator variables interact between themselves, it can be likewise affirmed that those factors increasing difficulty would reduce perseverance. Conversely, those factors increasing perseverance will reduce difficulty. The final outcome of a course is a product of the relative balance of each group of factors. For example, if the factors that increase difficulty are too high, then students will tend to drop and achievement indexes will decrease.

Surrounding this set of variables that can be directly or indirectly controlled by program staff, there are a number of uncontrollable variables that vary either at random or according to broader societal trends. Among these, one may find individual variables such as attainment, age, gender, content preferences, and socio-economic background. They cannot be overlooked in any model, but the role of educators is mostly to measure their impact and adjust the program accordingly to obtain the desired outcomes.

This generalized construct may be validated through comparative studies. So far, it is corroborated by the data of this project, and by the independent studies of Woodley and Parlett (1982) and Schwittmann (1982), mentioned elsewhere. The first one has been discussed in detail in the review of literature; the reader may want to review the appropriate sections on pages 12 to 16. The second one will be commented here because of its similarities with the model emerging from this study.

Schwittmann Model states that the "degree of learning success," a measure that corresponds to the pass rate in the present study, is a function of three groups of variables:

> --the study time needed with its determinants, "cognitive learning prerequisites" and "quality of teaching";
> --the perseverance with its determinants, "affective learning prerequisites" and "quality of teaching"; and
> --the possible study time with its determinants, "recommended study time" and "available time." (p. 145)

Basically this model establishes the same determinants of perseverance that in Figure 3. However, the "study time needed," that would be equivalent to time elapsed or course difficulty, is only a function of the factors that reduce difficulty. The factors increasing difficulty are not taken into account. Nevertheless, they are very important to explain attrition and low achievement in some courses. It

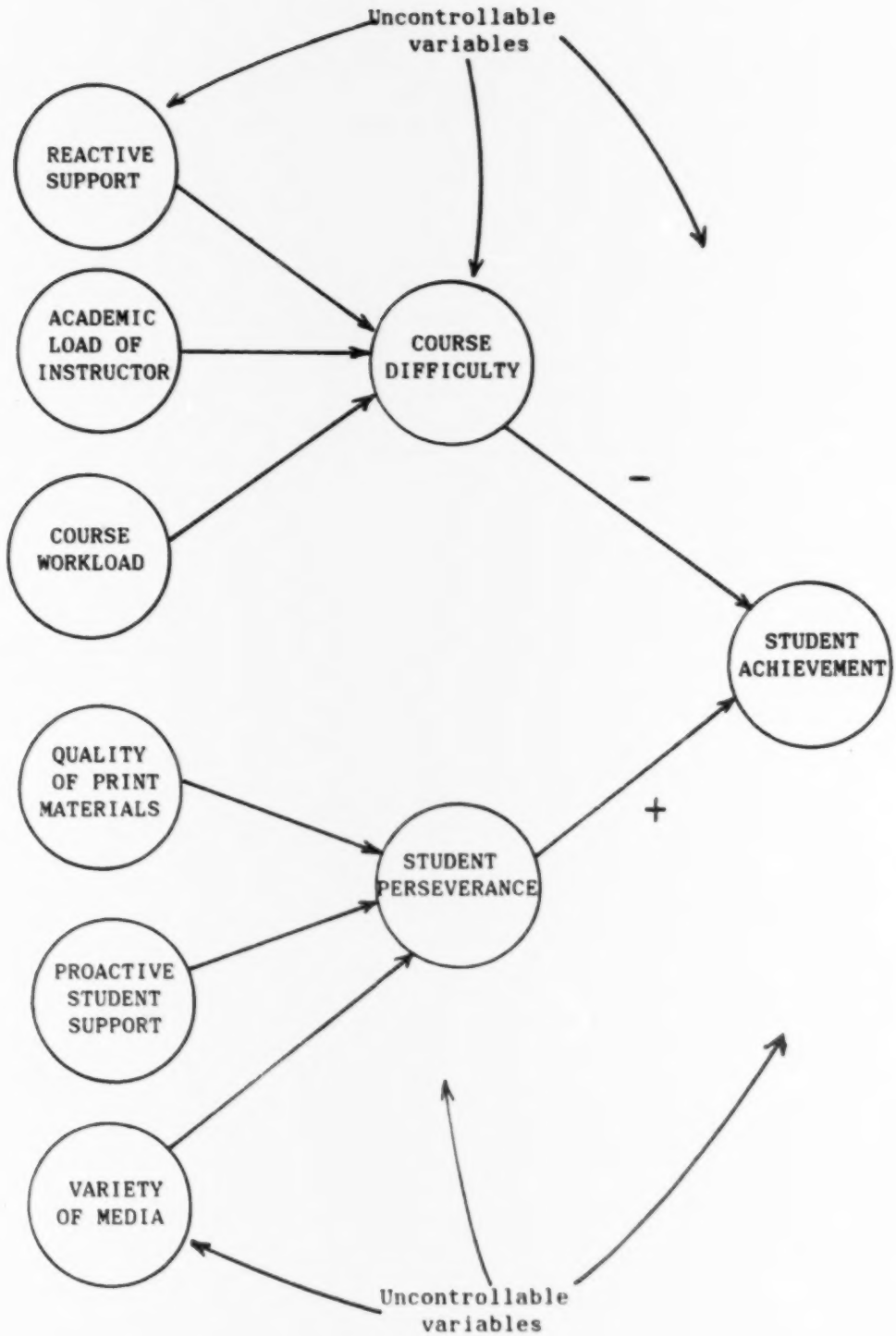


Figure 3. Generalized Model of Distance Education Course Outcomes

is interesting to notice that Schwittmann based his study on surveying students as primary source of data, and he used conceptual analysis instead of causal modeling to develop the model. However, his model is quite similar to the one discussed in this study.

Question No. 3

Does the causal modeling approach used in the study represent a sound alternative to other well known approaches for evaluating distance programs?

As observed in the previous Schwittmann model, it is possible to generate an explanatory construct without intense use of statistics. Still, the use of model-building techniques such as path analysis brings some advantages to conjectural procedures. First, path analysis allows one to search among a multiplicity of variables for a fitting model without rejecting a priori any of such variables; it avoids anchoring one's judgement. Second, the method allows one to compare courses in a system provided that the data are available. Third, the method includes procedures for testing the validity of causal assumptions. Fourth, the analysis can be easily repeated since it is based on clearly specified steps. Finally, the process of analysis may be integrated to the standard operation of the system thus reducing the costs of evaluation; which are very high when the developmental testing or congruence approaches are permanently used.

As limitations of the method, one must include first the assumption of linearity of relationships that was discussed in Chapter Three. The linear paradigm is only a rough form of representing relations among educational phenomena; even more, some relationships do not fit well into a linear equation. For instance, the relationships between the time elapsed to complete and all the dependent variables seem to fit better into a polynomial equation. Secondly, the path model is an abstraction that does not tell anything about the idiosyncrasy of each program or course. For instance, the quality factors in mathematics textbooks cannot be the same as the quality factors in health education textbooks; it is necessary to make gross assumptions to compare both kinds of materials. Finally, one can only include interval-scale variables in path models. This means that it is necessary, then, to transform formerly ordinal variables--i.e., the quality of textbooks--into interval-like scales by using numeric manipulation. In doing so, the qualitative information about the textbooks is lost. Furthermore, some nominal variables, such as gender, academic department, or discipline will not enter in the causal models even though they are important.

From the previous discussion, it follows that causal modeling cannot be the sole evaluation strategy of a system but a monitoring device that tells program participants what factors they should mind, in order to generate desired changes. Causal analysis will be supported then with qualitative evaluations which allow the definition of appropriate strategies utilized in improving outcomes of each course.

Question No. 4

Is it possible to derive from the statistical model decision rules or policy guidelines to improve program outcomes?

The final and generalized path models show that the factors determining outcomes of distance education courses are mostly alterable

variables. By establishing adequate policies, it is possible to generate desirable changes even in a short period of time. It follows a discussion of the main policy guidelines arising from the model.

1. Periodic Redesign of Courses.

It was observed that the age of the course had a direct negative impact on several variables: the quality of print material, the variety of media, and the rate of pass. As these variables are related to others, the indirect impact is even greater. This fact calls for a policy of mandated revision of the courses every 5 to 7 years, depending on the degree of student success in the course. This revision must be a thorough process in which the whole structure of the course is redesigned and the problems experienced with the old version are taken into account. The textbook would be compared to other books existing in the market at the time, and the study guide would be rewritten with new assignments and exam forms.

This policy would have a significant impact not only on student achievement but also on the instructors' morale. They will be conscious of working with some of the best texts available and with updated assignments; thus preventing "mechanization" of the correction process. It is anticipated that the added costs of renewal of materials will be compensated by increments in completion rate and pass rate; which, in turn, will augment the number of successful students who register for more distance courses. This idea is reinforced by the incidental observation of the author that students who pass with good grades are more likely to register for other courses than those who get bad grades or drop. It is anticipated that renewed courses will be more competitive with those offered in other distance education systems, which may contribute to ameliorate the problem of enrollment decline as found in most DIL programs.

2. Regulation of Course Workload

It is known that the most influential factor on the time elapsed for completion is the workload or number of assignments, which includes number of lessons for submission, number of pages to read, and number of exams. This factor has also a strong indirect influence on the rate of attrition--the inverse of completion--as seen in the path model. However, it was observed that a low workload of less than 10 lessons was associated with lower grades; probably because the students had fewer opportunities for self-evaluation. It seems, then, that a range of 10 to 21 lessons is recommendable.

Some problems may be foreseen in the implantation of a policy like this, since it may collide with the opinion of the professors in charge of the courses. As they are paid by the number of lessons corrected, less lessons may signify less return. But lowering the number of lessons may have at large a positive impact on financial returns, because drop out will diminish; as it can be inferred from the model.

3. Establishment of Criteria for Selection and Production of Print Materials.

The path model indicates that the quality of print materials, meaning textbooks and study guides, is a multi-determinant variable. It

has positive effects on the variety of media, faculty support, completion, grades, and pass rate. These effects are not grand, but regarding the multiple indirect paths involved they show that quality of print is actually a major contributor to achievement.

The process of improving the quality of textbooks and guides involves a number of coordinate steps. In the first place, it is necessary to establish a list of the desirable characteristics of these materials; the list of media variables in Table 1b is a good source of information for that. It points at organization criteria and presentation techniques recommended from research. This list will be discussed with the course authors prior to the writing process. Some examples of successful textbooks and study guides may be considered at this point. It is important to insure that the selected book or books have a good standing in respect of the use of the variables in the list. In the second place, when the author hands in the trial lesson of the course, the list of criteria will be reviewed again to evaluate applications. Additional advising of the author may be considered, if the results are not satisfactory.

The former systematic steps plus, the academic and economic incentive of producing a high quality study guide, may have a definite positive effect in distance courses. It is important that the whole process is also applied to courses subject to revision, which apparently are the most problematic in the current status of the program.

4. Enrichment of Course Packages.

This policy is closely related to the former; it refers to ways of increasing the variety of media delivered to the students. The results of the study indicate completion and rate of pass can be significantly increased by using relatively inexpensive media such as workbooks, supplemental readers, casebooks, and guides to field activities. These materials have the added value of increasing student involvement in learning and lessening the undesirable aspects of the distance situation.

Additionally, it would be convenient for DIL and similar programs to experiment with the audio-cassette as a complement to print. This medium is especially effective when used for providing supplementary "tutorials." They can contain introductory comments of the instructor to each lesson in the course plus some explanations of especially difficult points. To adequately conceive these tutorials, the instructors may want to review a sample of lessons returned by students in order to detect problems. If the course is produced for the first time, a meeting with peers that have taught the course may be equally helpful. By contrast, the findings do not suggest that an expensive medium such as television would produce remarkable improvements in outcomes.

5. Enrichment of Faculty Support

If any strategy can cause dramatic improvements in completion and achievement of distance learners, faculty support is the most likely answer. It can be stated that the negative impact of assessment-centered support can be reversed to a positive effect if instructors assume a more active communication style. There is sufficient evidence in the

literature on this point. The problem is how to improve instructor student communication without causing large expenses. It follows a discussion of two approaches that can be helpful.

The first critical point is training; it was indicated elsewhere that the functions of the distance advisor considerably differ from those of the classroom instructor. Distance advisors need to rely more on indirect forms of communication than their peers in the campus do. Among these indirect forms one may list comments written to assignments, correspondence or telephone advising, handouts, audio-tutorials, and referral to on-site resources. The latter requires that the instructor keeps an updated record of institutions, programs, and persons that can provide aid to the student in areas related to the course content; when some special problem arises with a student, the instructor may refer him or her to on-site resources. To encourage instructors to use these forms of indirect communication, the distance education department may be able to prepare a brochure describing these techniques, their functions, and related examples. This booklet can be used to conduct workshops with prospective or current instructors as a way of strengthening correct attitudes and skills.

One second approach to improve communications, is to encourage contacts among the students. There is considerable evidence that face-to-face interaction may be very helpful to students in the motivational and cognitive aspects (Holmberg, 1981, pp. 61-64). The organization of study teams requires an efficient referral service by the central administration of the program. Students who are interested in being members of study teams will call or write to the central office and they will receive information about neighbor students interested in doing the same.

6. Assurance of Support Resources

The number of students enrolled in a distance course has a significant impact (beta=.29) on the time elapsed to complete. This means that the larger that number is, the cohort as a whole tends to take more time to finish. The logical explanation is that the instructors need more time to process assignments and their slow feedback causes insecurity to students who, in turn, will work slower or decide to quit. The implication is that the number of students attended by instructor, or "class," must be kept within manageable size. This does not mean to establish a fix number of students per course, but to define criteria about the resources that are necessary to attend each group of students according to its size. It may be established, for instance, that instructors who work with large classes are required to contract teaching assistants to help them with corrections.

Which are appropriate criteria to define the necessary resources? This is problematic issue, because the courses are not uniform in respect to assignments and advising requirements. The bare inspection of the course data in the present study indicates that the courses having larger time elapsed to complete can be as having high verbal or high mathematical content. The first ones require extensive reading and writing of essays; the second ones have intermediate calculus and/or algebra as prerequisites. This information could be the basis for

defining categories of courses according to workload and, in turn, specifying the minimum and maximum number of work-hours required from the instructor in order to accomplish the associated academic tasks. These tasks must include to provide feedback to students by direct and indirect means.

Question No. 5

Under what limitations of contextual, institutional and methodological nature must be regarded the conclusions of the study? To what extent are they generalizable?

The possibility of generalizing the conclusions of the study to other distance education programs is restricted by a number of factors. They are fundamentally methodological and contextual, the latter including some institutional factors. The most important methodological constraint was in the sample selection. Due to the absence of dedicated financial resources for the study, only 25 courses were included in the sample out of 190 that were active at the moment. In order to insure some representativeness, the population of courses was divided into categories of completion and success and sample members were drawn from each category. However, these procedures do not guarantee absence of bias. Another factor affecting sampling is that only one of the DIL program sub-populations was selected for the study: the credit and degree students. Most of them are 18 to 23 years old, study full-time, and take distance courses only as a complement to campus instruction. Consequently, they do not correspond to the typical profile of the distance student: adult, married, employed, and having interrupted studies for sometime. It may be inferred, that due to the characteristics of the sample, the parameters for grades, completion rate and pass rate are too high. Conversely, the average time to complete is too low.

One second limitation in is the lack of sufficient information about the faculty subsample. It was mentioned that only 60 percent of the questionnaires were returned. Due to this problem, it was necessary to estimate missing values of faculty support; which is a key variable of the path model. The estimation procedure, although statistically substantiated, always involves the possibility of error; even more if the sample is small.

The contextual limitations are related to the question of whether the program under study adequately represents distance education processes. Two major trends seem to characterize the most recent evolution of distance programs: the intensive development of instructional technology and the enrichment of the student support functions, especially those related to the tutor-counselor. Both components are in early stages of development in the program under study. This means, that some important factors were not investigated simply because they were absent. Among them, one may mention audio-tutorials, laboratory kits, advising through computer interaction, learning centers, and field projects directed by tutors. However, these elements are typical of projects that offer entire professional programs through distance education. In the United States, the predominant functions of this kind of programs are to supplement existing facilities of on-campus instruction both for traditional and non-traditional clienteles.

Having on account these limitations, it is tenable to affirm that the outcomes of the study can be mainly generalized to distance education programs based on the model of independent study, in which the student largely works by his/her own means with a minimum support from professors; a model quite widespread in the United States. However the findings related to the influence of print materials, discussed below, may be generalizable to a broader variety of distance programs that use this medium.

External Implications of the Study

Confirmation of Relevance of the Cognitive Approach to Text Design

The set of indicators of quality of textbooks and study guides used in the data collection instruments (Appendix A) are drawn from research on reading, using a cognitive orientation. The evidence supporting different presentation techniques such as overviews, advance organizers, adjunct questions, structured tasks, vocabulary aids, and review questions is mostly experimental. This study shows that these variables continue to be relevant in a field setting, despite the intervention of many uncontrolled factors.

The list of techniques of presentation based on the cognitive approach (Table 1b) defies summarization, all of them seem to be important. However, it is possible to find some common dimensions into them that can be used to explain why they are effective. To the understanding of the author, the most relevant dimensions are the following: (1) amount of control over learner, (2) activation of relationships, and (3) depth of processing.

The amount of control refers to the ability of the techniques to induce in the learner a pre-conceived conceptual organization of the text. Highly determinant techniques are summaries, lists of objectives, and staging devices (i.e., heading and subheadings), because they impose on the learner the authors view of content. Less controlling techniques are structured tasks, and adjunct questions. It is anticipated that the instructional materials at the postsecondary level must combine both kinds of techniques. The first ones guide the student to the essential ideas and the others allow for creativity of the reader.

The activation of relationships refers to the amount of connections in the learners cognitive structure that can be elicited by the text. There is low activation in vocabulary aids, redundancy, and staging techniques; while activation is high in advance organizers and adjunct questions. The use of one set of techniques with preference to other in the text or study guide depends on the familiarity of students with content. If the group of students does not have some exposure to content, it is convenient to use low activation techniques until they are able to do more complex work.

Depth of processing refers to whether the techniques allow the students to grasp the surface or passage structure of a text, or the knowledge or deep structure. Techniques as redundancy, staging devices, and learning objectives are pathways to the surface structure; while summaries, advance organizers, and adjunct questions allow to access the deep structure.

To conclude, the effectiveness of textbooks and study guides is enhanced by the use of presentation techniques that facilitate cognitive processing. However, they should not be mechanically applied; it is necessary to analyze first the conceptual structure that the author wants to communicate or wanted to communicate, if the book has been already written; secondly, it must be decided what content sequence and techniques of presentation will be used to facilitate the student's access to the structure. The process of access may be expeditive or very gradual, depending on the previous knowledge on the subject by the student. Further evaluation of the learners results will indicate whether the techniques of presentation were helpful for learning or not.

Implications for Decision Support Systems

So far, the construction of the model of course outcomes has been seen under the purview of program evaluation. In other words, the function of the model is to provide a "theory of the program" that allows to connect program inputs with outcomes and facilitates policy-making. One alternative view is to consider the model as a component of the information support system of the program, which leads to a broader perspective of analysis.

Distance education systems are compelled to keep large storage of data, in order to efficiently accomplish their functions. As the participants in the programs--students, instructors, and staff--are separated in space and time, an efficient use of information is necessary to keep these system components from falling apart. The operations typically requiring intensive use of information processing are the following: student registration and billing; inventory and distribution of learning materials; coordination of the flow of assignments between students and instructors; and grading and certification. One may think that, with an adequate design of the data bases, this information needed for supporting the daily transactions of the system can be used for planning, organization, implementation, and recycling decisions. In other words, the transactions data can be incorporated into Decision Support Systems (DDS) tailored to distance education programs.

It is convenient to clarify the nature of the DDS before analyzing how they can be applied in this setting. Decision support systems are computerized information processing systems tailored to specific needs of the users. To be effective, they must have a number of requirements summarized by Tetlow and Brinkman (1984). These are:

1. Support for semistructured (underspecified) decisions
2. Support for all phases of decision-making (intelligence, design, choice, implementation)
3. Combination of modeling (analytic) techniques with database and data-presentation techniques
4. Emphasis on ease of use and flexibility/adaptability.
5. An interaction with transaction processing (Electronic Data Processing) and other information systems, such as MIS and office. (p. 7-4)

The model developed in this study can be the basis for a DSS aimed at supporting decisions related to planning, design, implementation,

evaluation, and revision of distance courses. These decisions are semistructured, since there is no definite set of standards of quality. In order to improve course quality, it is necessary to observe in reality how the program variables affect results: which is the major purpose of an outcome model.

How can such DSS for distance courses be created? It will not be intended here to provide a detailed answer to this question; suffice it to say that the data analysis procedures of the study would be the core of that system. It is necessary then to construct an electronic data base that would have three major files:

--a students file, with data such as name, age, gender, address, course(s) enrolled, date of enrollment, dates of submission of assignments, partial and final grades, and date of completion.

--an instructors file, with data such as name, age, gender, department, course(s) taught, address, academic load, years of teaching experience, and type of training in distance education.

--a media file, with data such as course, date of creation, date of revisions, list of media, number of assignments, index of workload, index of quality of textbook(s), and study guide, completion rate for last 10 semesters, average time elapsed to complete, average of grades for last 10 semesters, and pass rate for last 10 semesters.

These files will be updated through: (1) daily transactions, (2) student survey applied at the moment of registration, (3) annual survey of faculty, (4) direct input by the program staff, and (5) automatic computation of some variables (i.e., average time to complete). This DSS would allow to make predictions about course outcomes on the basis of input variables and generate a number of tailored reports for administrators, liaison officers of academic units, course developers, and instructors.

Recommendations for Future Research

The most immediate recommendations that emerge from the present research are related to the improvement of the model of course outcomes. Three important limitations of the model can be remedied through appropriate design of inquiry: (1) the insufficient information about faculty support; (2) the lack of knowledge about the affective determinants of student perseverance; and (3) the still unclear relationship between time elapsed and completion.

With respect to faculty support, it is recommended to use both interview and survey methods to inquire about the attitudes and behaviors of instructors involved in the distance system. The research instruments must include, at least, references to the following factors: attitudes towards distance education as compared to conventional teaching, types of direct and indirect communications that they establish with the students, criteria used for assessment, and forms of providing feedback about assignments.

The analysis of perseverance must rely on direct surveying of students, to obtain measures of motivation and the determinants of motivation. It is recommended to use the framework of expectancy

theories (Miner, 1980) to work with the notion of perseverance. Expectancy theories have been developed to explain persistence of workers in a job situation. The different models of expectancy have in common the notion that people preferences for goals are affected by the perceived satisfaction in achieving the goal as compared to the required efforts. This idea, although originated in industrial settings, can be relevant to explain why students do or do not persist in distance courses.

The critical variables that have to be measured in a study on perseverance are basically: (1) the strength of the student's interest in completing a given course; (2) his other perception of elements that facilitate to reach that goal (i.e., quality of media, degree of faculty support); and (3) his other perception of the elements that hinder that possibility (i.e., assignments, lack of interaction with instructor). The predictive power of the path model might be boosted by including such kind of variables.

Finally, the suggested curvilinear relationship between time elapsed and completion must be clarified by analyzing a larger sample of courses. Two alternate hypotheses would be tested: that the relationship is actually curvilinear, or that there is interaction between both variables; as suggested in the generalized model.

Final Comments

The success of distance programs, as shown by the different steps of analysis in this study, is the product of a careful orchestration of multiple factors. There is no single variable that can cause dramatic improvement of outcomes, but adequate combinations of factors are able to do it. The essential problem for the practitioner of distance education may be stated as one of optimizing factors that have positive results, versus controlling factors that may have negative impact. Both goals have to be pursued within the constraints of the program. Causal modeling represents then a powerful method to identify what actions of the program planners can be more successful in one or the other direction.

The ultimate goal of application of causal modeling in the present context increase faculty and student involvement in learning, despite the constraints of the distance situation. There is some concern in academic circles about this mode of teaching because it is considered that there is no involvement without personal interaction. Perhaps this concern is echoed in one of the recommendations of the Study Group on the Conditions of Excellence in American Higher Education (1984), which reads: "Learning technologies should be designed to increase, and not to reduce, the amount of personal contact between students and faculty on intellectual issues" (p.29). However, the present study shows that it is also possible to enhance intellectual communication by means of an adequate use of technological systems.

It is shown that high levels of involvement can be expected from distance learners if a number of preconditions are met: that the instructional materials are designed to facilitate access to the structures of knowledge by means of the presentation techniques; that an adequate variety of media is provided through the learning packages;

that the faculty members assume a communicative style of interaction, instead of merely reacting to problem situations; and that adequate human resources in quality (through training) and quantity are assured for each course. These factors increase student perseverance and are able to generate high levels of achievement.

Working with models to intervene educational programs is not a sort of panacea that is guaranteed to generate improvements. There is a need for painstaking testing before constructing models that work. If the data used to develop the model have measurement errors, or the hypothesis used to connect inputs and outputs are invalid, all decisions based on the model are likely to be of no consequence or even cause negative effects. Thus, the construction of models must be seen as a dynamic process that involves a set of steps: setting program goals, modeling, intervening the program on the basis of the model, assessing outcomes, and then sending feedback information to model design. The best way of keeping alive this process is to include model construction and testing as components of the information support system of the program.

If distance education is ever to become a more respected form of instruction at the postsecondary level, fulfilling the aspirations of a tremendous variety of learners, constant evaluation of the programs must be performed. Unfortunately, at the present time, not enough is known about the interaction of program factors. Consequently, there is an absence of tools for policy-making. It is necessary to undertake the task of doing integrative studies with multiple variables; a task in which the contribution of causal modeling may be formidable. The desire of the author is that the present limited exercise with this method would encourage others to perfect its application; thus, it can be transformed in an effective tool for improving academic quality in an area that up to the present has been neglected by the mainstream of research in higher education.

BIBLIOGRAPHY

Aaronson, Donis and Fewes, Steven (1984). Reading strategies for children and adults: some empirical evidence. Journal of Verbal Learning and Verbal Behavior, 23, 189-220.

Achen, Chirstopher H. (1982). Interpreting and using regression. Beverly Hills, Ca.: Sage Publications.

Alexander, K. and Eckland B. (1975). Basic attainment processes: a replication and extension. Sociology of Education, 48, Fall, 457-95.

Alwin, D. F. (1974). College effects on educational and occupational attainments. Sociology of Education, 48, Fall, 475-495.

Anderson, Richard S. (1984). Some reflections on the acquisition of knowledge. Educational Researcher, 13, 9, 5-10.

Anderson, Thomas H. and Armbuster, Bonnie (1982). Reader and text-studying strategies. In Otto, W. and White S. (Eds.) Reading expository material. New York: Holt, Rinehart and Winston.

Asher, Herbert B. (1983). Causal modeling. Second Edition. Beverly Hills, Ca: Sage Publications.

Astin, Alexander W. (1975). Preventing students from dropping out. San Francisco: Jossey-Bass.

Ausubel, D. P. and Robinson, F. G. (1969). School learning: An introduction to educational psychology. New York: Holt, Rinehart and Winston.

Bääth, John A. (1979). Correspondence education in the light of a number of contemporary teaching models. Malmo, Sweden: LiberHemonds.

Bääth, John A. (1980). Postal two-way communication in correspondence education. Lund, Sweden: Gleesup.

Bääth, John A. (1982). Distance students learning: empirical findings and theoretical deliberations. Distance Education, 3, 1, 6-27.

Baldridge, J. Victor; Curtis, David V.; Ecker, George P.; and Riley, Gary L. (1977) Alternative models of governance in higher education. In Baldridge J. Victor and Deal Terrence E.; Governing academic organizations; Berkeley, Ca.: McCutchan.

Bates, Anthony W. (1980). Towards a better theoretical framework for studying learning from educational television. Instructional Science, 9, 393-415.

Bates, Anthony W. (1982). Roles and characteristics of tele- vision and some implications for distance learning. Distance Education, 3, 1, 29-50.

Blalock, Hubert M. (1979). Social statistics. Second edition. New York: McGraw-Hill.

Bloom, Benjamin (1981). Research on alterable variables in education. The Phi Delta Kappan, 5, August, 13-19.

Bowles, S. and Levin, H. M. (1968). The determinants of achievement: An appraisal of some recent evidence. Journal of Human Resources, 3, 1, 3-24.

Bloom, Benjamin S.; Madaus, George F.; and Hastings J. Thomas. (1981). Evaluation to improve learning. New York: Mc Graw-Hill.

Briggs, Leslie N. (1968). Sequencing of instruction in relation to hierarchies of competence. Monograph No. 3. American Institute for Research in the Behavioral Sciences. Pittsburg.

Brunner, Edmund, D. Wilder, C. Kirchner and J. Newberry (1959). An overview of adult educational research. Chicago: Publications of the American Adult Education Association.

Burstein, Leigh and Miller, M. David (1981). Regression- based analyses of multilevel education data. In Boruch, Robert F.; Worthman, Paul M.; and Cordray, Davis S. (1981); Reanalyzing program evaluations. San Francisco: Jossey Bass.

Campbell, David E.; Steenbarger, Brett N.; Smith, Timothy W.; and Stucky, Rita J. (1982). An ecological systems approach to evaluation. Evaluation Review, 6, 5, 625-648.

Chacón, Fabio J. (1982). A course evaluation system for an Open University. ERIC Clearinghouse in Higher Education, 17, February.

Cohen, Jacob (1983). Multiple regression as a general data-analytic system. In Strueing. E.L. and Brawer, M. B. (Eds), Handbook of evaluation research. Beverly Hills, California: Sage Publications.

Coldeway, Dan O. (1982). Recent research in distance education. In Daniel, John C.; Stroud, M. and Thompson, J. (1982) (Eds.). Learning at a distance: A world perspective. Edmonton, Canada: Athabasca University Press.

Connors, Brendan (1981). Assessment in the distance education situation. In Kaye, Anthony and Rumble, Grenville; Distance teaching for higher and adult education. London: Croom Helm.

Cook, Thomas D. and Campbell, Donald T. (1979). Quasi- experimentation. Chicago: Rand McNally.

Craik, F. I. M., and Lockhart, R. S. (1982). Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 11, 671-684.

Cronbach, Lee J. (1963). Course improvement through evaluation. Teachers College, 64,672-683.

Cronbach, Lee J. and Associates (1980). Toward Reform of Program Evaluation. San Francisco: Jossey-Bass.

Cronbach, Lee J. (1982). Designing Evaluations of Educational and Social Programs. San Francisco: Jossey-Bass.

Crombach, Lee J. and Snow, Robert P. (1967). Aptitudes and instructional methods. New York: Irvington Press.

Cross, K. Patricia (1982). Adults as learners. San Francisco: Jossey Bass.

Daniel, John C.; Stroud, M. and Thompson, J. (1982) (Eds.). Learning at a distance: A world perspective. Edmonton, Canada: Athabasca University Press.

DIL (Department of Independent Learning) (1982). Independent study by correspondence. Annual report. (Available from Division of Educational Telecommunications, The Pennsylvania State University, State College, Pa.)

DIL (Department of Independent Learning) (1983). Independent study by correspondence. Annual report. (Available from Division of Educational Telecommunications, The Pennsylvania State University, State College, Pa.)

DIL (Department of Independent Learning) (1984). Independent study by correspondence. Annual report. (Available from Division of Educational Telecommunications, The Pennsylvania State University, State College, Pa.)

DIL (Department of Independent Learning) (1985). Independent learning. Annual report. (Available from Division of Educational

Telecommunications, The Pennsylvania State University, State College, Pa.)

Ebert, Herbert W. (1983). Multivariate methodologies for evaluation research. In Strueing, E. L. and Brewer, M. B. (Eds.), Handbook of evaluation research, Beverly Hills, California: Sage Publications.

Eisner, E.W. (1967). Educational Objectives: help or hindrance?. The School Review, 75,250-260.

Eisner, Edward (1978). Thick Description. In Hamilton, D. and others; Beyond the Numbers Game. Berkeley, CA.: McCutchan.

Erdos, René F. (1964). Teaching by correspondence. Unesco source books on curricula and methods, No. 3. London: Longmans-UNESCO.

Feasley, Charles E. (1982). Distance Education. Article in Mitzel, Harold (ED.) Encyclopedia of educational research. Fifth Edition. New York: The Free Press.

Ferraris, M.; Midoro, V.; and Olimpo, G. Validation processes for instructional systems. In Aspects of educational technology XV: Distance learning and evaluation. London: Kogan Page.

Frase, Lewis T. (1973). Integration of written text. Journal of Educational Psychology, 65, 252-261.

Freeman, Howard E.; Rossi, Peter H. and Wright, Sonia R. (1979). Evaluating social projects in developing countries. Paris: Organization for Economic Cooperation and Development.

Fyfe, W. (1981). The production and evaluation of materials for a distance learning course. In Percival, F. and Ellington, H. Aspects of educational technology XV: Distance learning and evaluation. London: Kogan Page.

Gagnè, Eillen D. (1978). Long-term retention of information following reading from prose. Review of Educational Research, 48, 4, 629-665.

Galvis, Alvaro (1982). Universidades a distancia en Latino- amèrica: Un anàlisis comparativo en lo metodológico. San Josè, Costa Rica: Editorial Universidad Estatal a Distancia.

Gibbs, Alberto (1982). Procesos criticos de la ense`anza a distancia: procesamiento del discurso y recursos matemagènicos. Caracas: Publicaciones de la Universidad Nacional Abierta.

Green, Edward J. (1963). The learning process and programmed instruction. New York: Holt, Rinehart and Winston.

Glynn, S.M. and Di Vesta, Francis J. (1979). Control of prose processing via instructional and typographical cues. Journal of Educational Psychology, 71, 2, 197-206.

Guba, Egon G. and Licoln, Yvonna S. (1981). Effective Evaluation: Improving the Usefulness of Evaluative Results Through Responsive and Naturalistic Approaches. San Francisco: Jossey-Bass.

Harris, W. J. A. (1975). The distance tutor: education by correspondence. Manchester Monographs, No. 3, Manchester, Eng.: Department of Adult Education of the University of Manchester.

Hartley, J. and Burnhill, P. (1977). Fifty guidelines for improving instructional text. Programmed Learning and Educational Technology, 14, 1, 65-73.

Hawkridge, David (1983). Evaluation of the Open University. Higher Education in Europe, 8, 3, 38-45.

Hilton, Thomas L. (1982). Persistence in higher education: an empirical study. College Board Report No. 82-5. New York: College Entrance Examination Board.

Holmberg, Börje (1981). Status and trends of distance education. London: Kogan Page.

Holmberg, Börje (1982a). Recent research into distance education. Part one. Hagen, West Germany: Publications of FernUniversität.

Holmberg, Börje (1982b). Recent research into distance education. Part Two. Hagen, West Germany: Publications of FernUniversität.

Hoopper, Earl and Marilyn Osborn (1975). Adult students: education, selection and social control. London: Frances Printer.

Hunter, Joan H. (1983) (Ed.) Peterson's independent study catalog. Washington: National University Continuing Education Association.

James, Arthur (1984). Age-group differences in the psychological well-being and academic attainment of distance learners. Distance Education, 5, 2, 200-214.

Jencks, Christopher and Riesman, David (1977). The Academic Revolution. Chicago: The University of Chicago Press.

Kaye, Anthony R. and Rumble, Grenville W. (1981a). Distance teaching for adult and higher education. London: Croom Helm.

Kaye, Anthony R. and Rumble, Grenville W. (1981b). Analyzing distance learning systems. In Neil, Michael W. (Ed.). Education of adults at a distance. London: Kogan Page.

Keegan, Desmond (1980). On defining distance education. Distance Education, 1, 1, 13-36.

Keegan, Desmond and Holmberg, Börje (Eds.) (1983). Distance education: international perspectives. London: Croom-Helm.

Kim, Jac-On and Kohout, Frank J. (1975). Special topics in general linear models. In Nie, Norman H. et al; SPSS: Statistical package for the social sciences. Second edition. New York: Mc Graw-Hill.

Kintsch, Walter (1982). Text representations. In Otto, W. and White, S. (Eds.), Reading expository material; New York: Academic Press; pp. 87-102.

Kirkup, G. (1981). Evaluating and improving learning materials: A case study. In Percival, F. and Ellington, H. (Eds.); Aspects of educational technology XV: Distance learning and evaluation. London: Kogan Page.

Lewis, Brian (1972). Course production at the Open University: The problem of assessment. British Journal of Educational Technology, 3, 2, 108-136.

Lewis, Robert L. (1983). Learning through tele- communications. Publication of the American Association for Higher Education. Washington: The George Washington University.

Lewis, Roger (1981). How to tutor in an open-learning system. London: Council for Educational Technology.

Lewis, Roger (1982). The role of the correspondence tutor. In Daniel, J.R., Stroud, M.A. and Thompson, J.R. (Eds), Learning at a distance: A world perspective; Edmonton: Athabasca University Press; pp. 135-139.

Lockhart, R. S. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 11, 671-684.

Macdonald-Ross, Michael (1979). Language in Texts: a review of research relevant to the design of curricular materials. Review of Research in Education, 6. Ithasca, Ill.: Peacock.

Mager, Robert F. (1975). Preparing instructional objectives. Belmont, Cal.: Fearon Publishing.

Markle, Susan Meyer (1964). Good frames and bad, a grammar of frame writing. New York: Wiley.

Marland, Percy; Patching, William; Putt, Ian; and Store, Ronald (1984). Learning from distance-teaching materials: a study of student's mediating responses. Distance Education, 5, 2, 215-236.

Marland, Percy W. and Store, Ronald E.(1982) Some instructional strategies for improved learning. Distance Education, 3, 1, 72-106.

Marton, Ference (1979). Learning as seen form the learner's point of view. ZIFF Papiere 30. Hagen, Germany: FernUniversität.

Marton, Ference and Svensson, Lennart (1982). Orientation to studies, approaches to texts: A relational view. In Daniel, et al. (1982); Learning-at-a-distance: A world perspective; Edmonton, Canada: Athabasca University Press.

Martorana, S. V. and Kuhns, Eileen (1975). Managing academic change. San Francisco: Jossey-Bass.

McConkie, George W. (1978). Learning from text. Review of Research in Education, 5, 3-41.

McCormick, R. (1976). Evaluation of Open University course materials. Instructional Science, 5, 189-217. Amsterdam: Elsevier.

Mejia, William (1984). Manual del tutor. Bogotà, Colombia: Instituto Colombiano Para el Fomento de la Educaciòn Superior.

Melton, Reginald F.(1977). Course evaluation at the Open University: A case study. British Journal of Educational Technology, 8, 2, 57-64.

Meyer, Bonnie J. (1975). The organization of prose and its effects on memory. New York: American Elsevier Company.

Miner, John B. (1980). Theories of organizational behavior. Hindsdale, Ill: Dryden Press.

Neil, Michael W. (1981) (ed.) Education of adults at a distance. London: Kogan Page.

Nie, Norman H. et al (1975) SPSS: Statistical package for the social sciences. Second edition. New York: Mc Graw-Hill.

Otto, Wayne and White, Sandra (Eds) (1982). Reading expository material. New York: Academic Press.

Paine, Nigel (1983) Counselling: Defining the field. In Tait, A. and Sewart, D. (Eds.) International workshop on counselling in distance education: selected papers. Milton Keynes, England: Open University Press.

Pedazur, Elazar J. (1975). Analytic methods for the study of educational effects. Review of Research in Education, 3. Ithasca, Ill: Peacock.

Pedazur, Elazar J. (1982). Multiple regression in behavioral research. Second Edition. New York: Holt, Rinehart and Winston.

Penn State University (1984). Independent learning opportunities. State College, PA: Publications of the Independent Learning Services.

Peters, Otto (1983) Distance teaching and industrial production: A comparative interpretation in outline. In Sewart, David; Keegan, Desmond; and Holmberg, Börje: Distance education: International perspectives; London: Croom Helm.

Percival, Fred and Ellington, Henry (1981) (Eds.). Aspects of educational technology XV: Distance learning and evaluation. London: Kogan Page.

Perry, Walter (1981). The Open University. San Francisco: Jossey Bass.

Pichè, Gene L. and Slater, Wayne H. (1983). Predicting learning from text: A comparison of two procedures. Journal of Reading Behavior, 15, 4, 33-46.

Rogers, Everett (1962). Diffusion of innovations. New York: Free Press.

Rothkopf, Ernst (1982). Adjunct aids and the control of mathemagenic activities during purposeful reading. In Otto, W. and White, S. (Eds.) Reading expository material. New York: Academic Press.

Rumble, Grenville (1981). Evaluating autonomous multi-media distance learning systems; a practical approach. Distance Education, 2, 1, 64-90.

Rumble, Grenville and Harry, Keith (1982). The distance teaching universities. London: Croom Helm.

Schallert, Diane Lemonier (1982). The significance of knowledge: A synthesis of research related to Schema Theory. In Otto, Wayne and White, Sandra; Reading expository material; New York: Academic Press.

Schramm, Wilbur L. (1960). The impact of educational television. Selected studies from the research sponsored by the National Educational Television and Radio Center. Urbana, Ill.: University of Illinois Press.

Schramm, Wilbur L. (1977). Big media, little media, tools and technologies for instruction. Beverly Hills: Sage Publications.

Schramm, Wilbur L. (1982) Quality in instructional television. Honolulu: University Press of Hawaii.

Schwittmann, Dieter (1982). Time and learning in distance study. Distance Education, 3, 1, 141-156.

Scriven, Michael (1967). The Methodology of Evaluation. In Stake,R.E. (Ed.), Curriculum Evaluation. American Educational Research Association monograph serves on evaluation, No.1. Chicago: Rand McNally.

Sewart, David; Keegan, Desmond; and Holmberg, Börje. (1983) (Eds.) Distance education: International perspectives. London: Croom Helm.

Smart, John C. (1985) (Ed.). Higher education: Handbook of theory and research. New York: Agathon Press.

Stahl, Steven (1983). Differential word knowledge and reading comprehension. Journal of Reading Behavior, 15, 4, 33-46.

Stake, Robert E. (1978). Responsive Evaluation. In Hamilton, D. and others (Eds.), Beyond The Numbers Game: Berkeley, CA: McCutchan.

Strueing, Elmer L. and Brewer, Marilyn B. (1983) (Eds.) Handbook of evaluation research. Beverly Hills, Ca.: Sage Publications.

Study Group on the Conditions of Excellence in American Higher Education (1984). Involvement in learning: Realizing the potential of American higher education. Washington: U. S. Department of Education.

Stufflebeam, Daniel L.; Foley, Walter J.; Gephart, William J.; Hamonond, Robert L.; Guba, Egon G.; Memiman, Howard O. and Provus, Malcom M. (1971). Educational Evaluation and Decision-Making. Proceedings of the Phi Delta Kappa National Study Committee on Evaluation. Itasca,In: Peacock Publishers.

Tait, Allan and Sewart, David (1983) (Eds.) International workshop on counselling in distance education: Selected papers. Milton Keynes, England: Open University Press.

Tetlow, William L. and Brinkman, Paul T. (1984). NCHEMS-Decision support systems demonstrator. Boulder, Col.: The National Center for Higher Education Management Systems.

Thornton, James and Brown, James (1968) New media and college teaching. Washington: National Education Association.

Tyler, Ralph W. (1950). Principles of curriculum and instruction. Chicago: University of Chicago Press.

Urrego, Luis Eduardo. Criterios para la evaluaciòn de programas de educaciòn superior a distancia. Educaciòn y Sociedad, 1, 2, 113-144.

Veysey, Lawrence R. (1965). The emergence of the american university. Chicago: University of Chicago Press.

Wedemeyer, Charles A. (1981). Learning at the back door. Madison, Wis.: The University of Wisconsin Press.

Weick, Karl E. (1976) Educational organizations as loosely coupled systems. Administrative Science Quarterly, 21, 1, 1-19.

Weiss, Carol (1972). Evaluation Research. Englewood Cliffs, N.J.: Prentice Hall.

Wolfe, Lee M. (1985). Application of causal models in higher education. In Smart, J. C.; Higher education: Handbook of theory and research. New York: Agathon Press.

Woodley, Allan and Parlett, Malcom (1983). Student Drop-Out. Teaching at a Distance, 24, Autumm, 2-23.

Apppendix A.
The Pennsylvania State University
Independent Learning Services

FACULTY QUESTIONNAIRE ON INDEPENDENT LEARNING SYSTEM (ILS)
Register A
Instructor's Data

Course:

Professor's name: Department:

1. Experience in teaching:_____ years. Experience in ILS:_____years.

2. Please, list by code the courses that you taught between 30-June-1983 and 31-July-1984 (period of the study):_____

_____

3. Did you receive special preparation to work with distance or correspondence instruction? NO ( ) YES ( ).

If YES, describe:_____

_____

4. What criteria are used by your department to decide if a course is to be offered through the Independent Learning System?

_____

_____

_____

_____

5. Please, indicate the frequency of utilization of the following items in the ILS course that you supervised during the period 1983-1984.

Scale: (1) Never (2) Rarely (3) Occasionally (4) Often (5) Usually

Group letters to students ..... ( )
Individual letters about specific problems ..... ( )
Marks written directly in lessons or tests..... ( )
Written comments to lessons or tests..... ( )
Suggestions for additional readings written into lessons.. ( )
Phone calls accepted from students ..... ( )
Phone calls to students initiated by instructor..... ( )
Additional materials sent to students when required ..... ( )
Direct meetings with students for discussing problems..... ( )

Register B
Factors of Instructional Quality of Textbooks
Faculty Assessment

Rate the textbook used in the course according to the following criteria. Please, circle one answer per each criterion.

Title: \author
\text

Scale: (1) Poor or bad (2) Less than satisfactory (3) Satisfactory (4) More than satisfactory (5) Excellent

(*** Leave blank the criteria that are not applicable***)

Clarity of objectives.....	1	2	3	4	5
Suitability to the student's entry knowledge.....	1	2	3	4	5
General readability of the text.....	1	2	3	4	5
Actuality of content.....***deleted***.....	1	2	3	4	5
Coverage of the subject matter.....	1	2	3	4	5
Clarity in presentation of concepts and principles..	1	2	3	4	5
Pacing of information into chapters and/or units....	1	2	3	4	5
Use of examples or cases to illustrate key ideas....	1	2	3	4	5
Exercises and questionnaires.....	1	2	3	4	5
Summaries or reviews.....	1	2	3	4	5
Graphic design and presentation.....	1	2	3	4	5

Register C
Quality Factors of Student Guides
Faculty Assessment

Now, rate the "Student Guide" used in the course according to the criteria listed below. Use the same scale as in the former section.

Study Guide for course: \course

(*** Leave blank the criteria that are not applicable***)

Clarity of objectives.....	1	2	3	4	5
Suitability to the students' entry knowledge.....	1	2	3	4	5
General readability of the text.....	1	2	3	4	5
Actuality of content.....***deleted***...	1	2	3	4	5
Coverage of the subject matter.....	1	2	3	4	5
Clarity in presentation of concepts and principles..	1	2	3	4	5
Pacing of information into chapters and/or units....	1	2	3	4	5
Use of examples or cases to illustrate key ideas....	1	2	3	4	5
Exercises and questionnaires.....	1	2	3	4	5
Summaries or reviews.....	1	2	3	4	5
Graphic design and presentation.....	1	2	3	4	5

Register D
Workload of the Course

Please, estimate as accurately as possible the number of work-hours that an average student would require to complete the following aspects of the course in a standard semester in order to obtain a grade of "B" or more.

(*** Leave blank the items that are not applicable***)

	Minimum (hours)	Maximum (hours)
To study the textbook (s).....	_____	_____
To study the student guide.....	_____	_____
To prepare the lessons for submission.....	_____	_____
To prepare the test (s).....	_____	_____
To prepare the term paper	_____	_____
Other course activities	_____	_____

Comments:_____
_____
_____
_____

Register F
Overview

(1) For how many semesters has this course been administered?: _____

(2) How many revisions have been done?:____. Date of last:_____

(3) How many different instructional materials are used in the course? Indicate absolute numbers and describe those not listed.

	Number
Textbook.....	_____
Workbook.....	_____
Student guide.....	_____
TV program.....	_____
Handout.....	_____
Computer programs.....	_____
_____.....	_____
_____.....	_____
_____.....	_____

Comments:_____
_____
_____
_____

ABOUT THE AUTHOR

Fabio José Chacón-Duque was born in San Cristobal, Venezuela, December 8th of 1948. He completed a baccalaureate in Psychology at the Central University of Venezuela in Caracas (1969) and, shortly after, initiated a professional career in higher education as instructor of the College of Communication at Zulia State University, in Maracaibo. There, he was co-founder of the Center for Educational Television and conducted several projects in faculty development.

In 1977, he moved back to Caracas to serve as Coordinator of Evaluation of the National Institute of Training for the Petroleum Industry (INAPET). In 1978, he decided to join the faculty of the recently created National Open University (UNA) where he has held several positions in academic administration. During his service, he completed a Master in Higher Education at the Pennsylvania State University, wrote several publications on distance education issues, and acted as visiting lecturer to several institutions in his country, the Dominican Republic and Colombia.

Special distinctions he has received include the following: Travel grant by the West German Department of Academic Exchange; Fulbright Scholar Award; participation in the UNESCO project for distance education in Colombia; and scholarship from the Venezuelan Government, that allowed him to complete doctoral studies.

Penn State is an affirmative action,
equal opportunity university.
U.Ed. 86-428